The FOUNDRY

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Castings Benefited As Styles in Store Fronts Change

MODERN merchants fully realize that attractive window displays play an exceedingly important part in merchandizing any product. The ever increasing army of citizens who find great pleasure in indulging in the greatest of outdoor sports, window shopping, has been the force behind many of the remarkable changes in the exterior of thousands of retail establishments. As the cost of window decoration continues to mount, merchants are making radical changes in

Thousands of Retail Establishments Are Undergoing A Dressing Up Process Yearly

the fronts of store buildings to give an artistic setting to the beautiful displays. The automobile also may be given as a contributing factor in the dressing up process now under way, for the almost universal adoption of that vehicle has necessitated the widening of many main arteries of travel and the rebuilding of the fronts of many buildings. The desire for permanence as well as attractiveness has led many to the selection of both ferrous and nonferrous metals as building materials. Since the beautiful and intricate designs and the mass effects best can be produced in cast metals, the brass bronze and iron ornamentation used in building the latest type store fronts is made in the foundry.

Find Where Casting May Be Sold.

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Aluminum Castings

Downtown Church First in World To Have Spire Constructed of Aluminum Castings—Predict Structural Uses To Expand

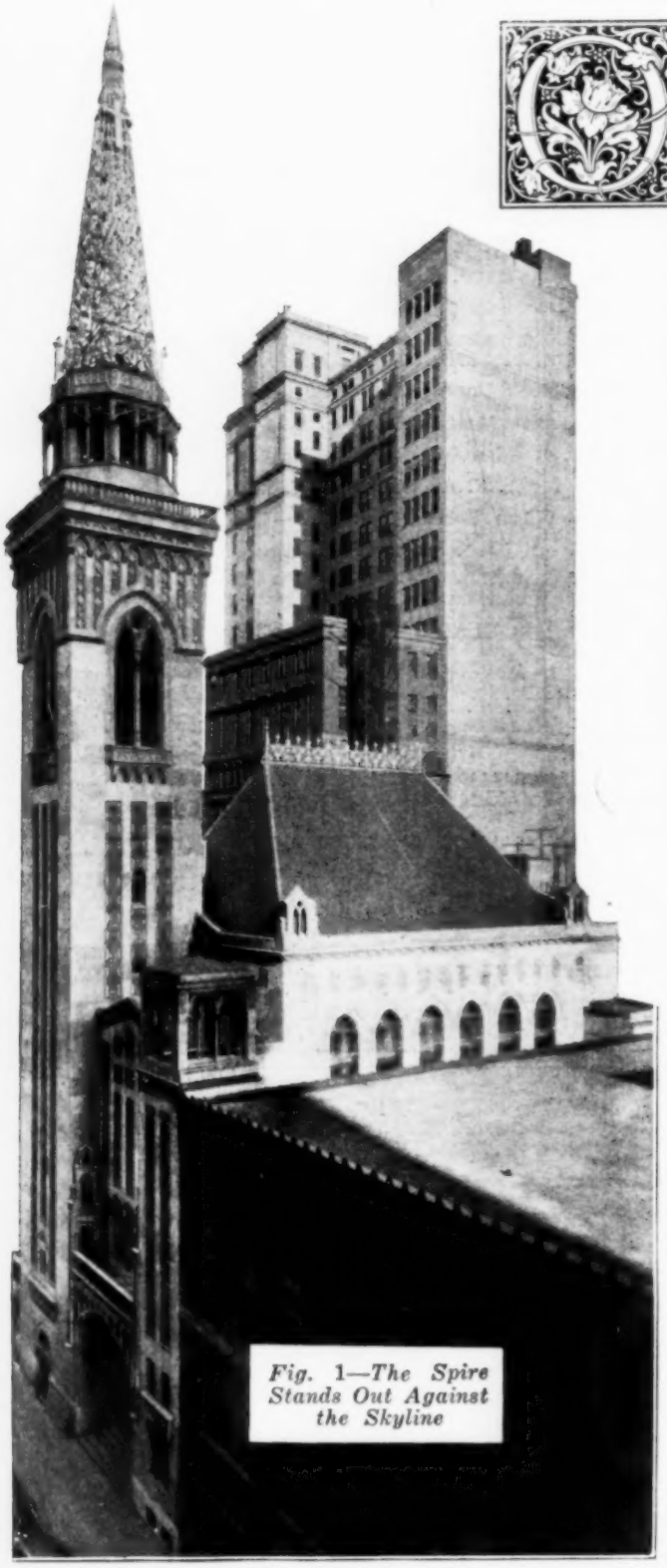


Fig. 1—The Spire Stands Out Against the Skyline

ONE HUNDRED YEARS ago Woehler, an eminent German scientist of that time, isolated aluminum as a fine gray metallic powder in small quantities by reducing aluminum chloride with metallic potassium. Oersted claimed to have reduced aluminum chloride with potassium amalgam in 1924, but Woehler found the method unsuccessful. Some years later Deville, a Frenchman, improved on Woehler's method and in 1854 was able to isolate aluminum in fairly large quantities. In 1855 aluminum still was considered a rare metal and sold in France for $115.00 a pound. By reducing cryolite with sodium, Percy in 1854 was able to produce aluminum; and in 1855, Rose electrolyzed cryolite and produced the metal.

The first successful thermal process was that developed by Cowles in 1886. This process called for the reduction of alumina by carbon in the presence of copper, in the electric arc furnace. However, this method did not yield aluminum but intermediate aluminum alloys. Although there was litigation between the owners of the patent which was granted to Hall in 1889 and the owners of the patent granted Bradley in 1892, due credit must be given Hall for the commercial development of aluminum.

How the shades of Oersted, Woehler, Deville and the other early workers would be amazed, if they could travel about this earthly plane and see the multitudinous uses to which aluminum—a rare metal of their days—is applied. The expansion from a few grains of a gray metallic powder isolated with difficulty in 1827 to a production in 1924 of over 373 million pounds accompanied by a price decline from $115.00 a pound in the early days to around 26 cents today is one of the outstanding features of the metallurgical developments during the past century.

Aluminum and its alloys have been the source of much general public interest due to their utilization in aircraft manufacture, especially with the advent of the all-metal airplane and the projected construction of a dirigible sheathed with the metal. Automobile and truck manufacturers use aluminum alloy castings such as crankcases, oil pans, transmission covers and cases, brake drums and shoes, pistons, radiator shells

Crown Pittsburgh Shrine

By

W. H. Lloyd and Edwin Bremer

and other aluminum castings to reduce weight.

Cast iron weighs 2½ times and brass three times as much as aluminum, volume for volume. In addition to its light weight aluminum is finding increased favor because it retains a pleasing color after weathering and is resistant to corrosion. It may be rolled, forged or spun, alloyed, fabricated and cast.

Aluminum or its alloy castings are made in an almost infinite number of shapes and sizes, and weigh from a few ounces per piece up to several thousand pounds.

Certain precautions must be observed in melting and to obtain the best results. The first essential is that the metal must not be overheated or soaked too long in the furnace. This causes a condition known as gassed metal. Another feature to be observed is that the metal is not poured too hot. Carelessness in this detail, which is quite prevalent, is the cause of many weak or defective castings. Owing to the low specific gravity of the metal, gases have a tendency to be trapped in the liquid metal instead of escaping through the sand unless the latter is sufficiently permeable.

Light, even ramming, if hand work is employed, or less compacting on molding machines will give the necessary porousness. Gates and risers must be properly proportioned and located to give the highest physical properties to prevent shrinks and cracks. Chills also are used to promote equal cooling of the thicker sections with the thin.

At the present time many foundries are engaged in producing aluminum and aluminum alloy castings. The Aluminum Company of America operates several large foundries one of which is located at Cleveland. This foundry produces castings made in green sand molds, permanent molds and under pressure by die casting machines. A plant also is devoted to forging connecting rods, airplane propeller blades, automobile hardware and other products that lend themselves to this type of manufacture.

As previously mentioned, aluminum and its alloys are cast into a great variety of shapes weighing from a few ounces up to several thousand pounds. In the small castings will be found parts for outboard motors for boats. Some of these castings are about 2 inches long and about ½-inch in diameter. Many other castings such as the rudder, crankcase, drive-shaft housing, flywheel and propeller also are cast of aluminum alloy. To give an example of the light weight of

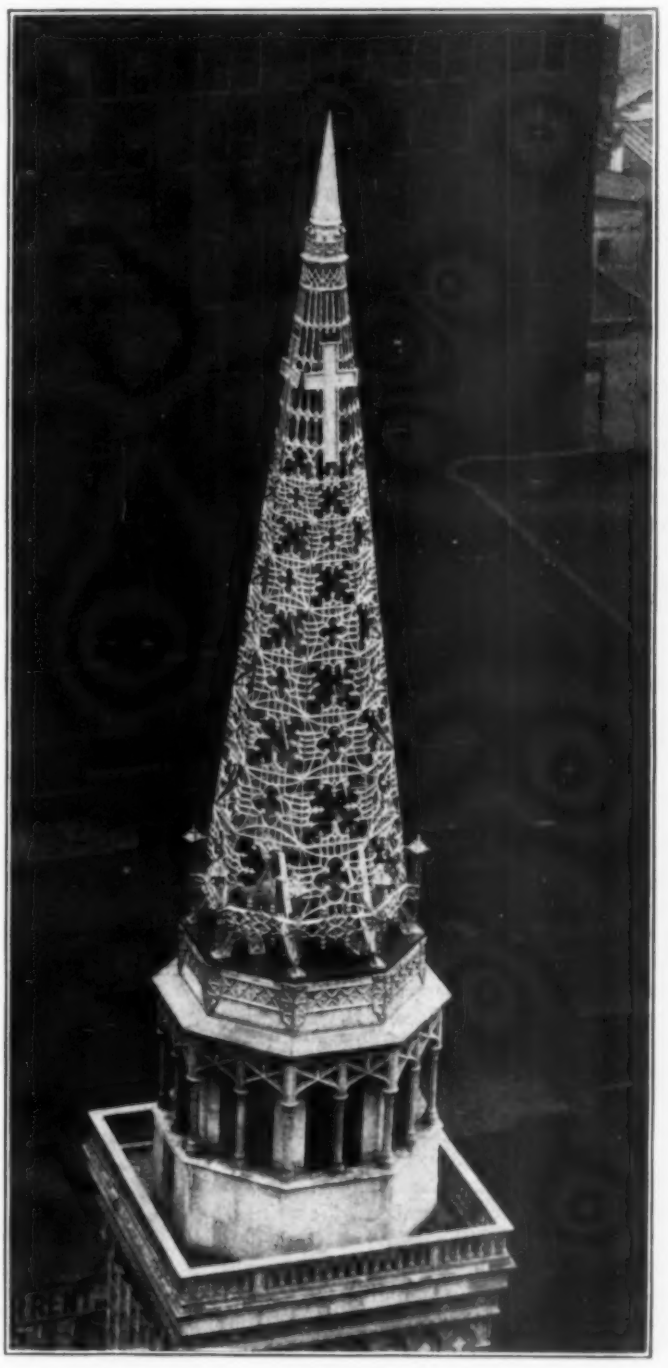


Fig. 2—Closer View Shows the Alternate Arrangement of the Panels and the Large Crosses that Are Illuminated at Night

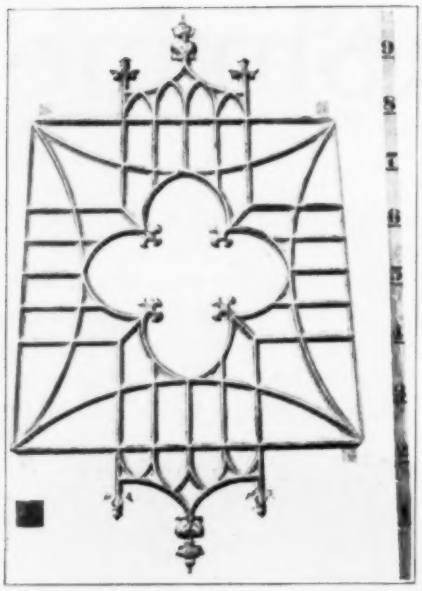


Fig. 3—One of the Large Panels. Projections Similar in Design to Those at the Top and Bottom Are Fastened to the Sides

aluminum castings, the rudder just mentioned is about 18 inches high and 10 inches wide with a thin section and weighs about 2½ pounds.

Among the more intricate, highly cored work might be mentioned crankcases and cylinder heads for motors as well as heater coils which are cast in one piece. These coils are spiral in form, about 12 inches across the greatest diameter and 30 inches high and have a metal thickness of ⅛-inch.

Large castings also have been made in the Cleveland foundry of the Aluminum Co. of America. The largest ones made in this foundry were four scavenger belt castings for a diesel engine. Each of these weighed 3800 pounds.

It would be almost an endless task to mention the varieties of aluminum castings and the purposes to which they are put, but the use of aluminum alloys is expanding all the time. New uses are being found in many unsuspected places. Recently the company cast the posts, panels and rail sections for two bridges that will span the Chicago river in Chicago.

A finial adorning the tower on the Standard Oil building in New York is made of aluminum and recently the designs for a number of castings to be placed on the Warren Gameliel Harding memorial at Marion, O., were completed and the molding of these will soon be under way. In all, the memorial will require 350 separate castings with a total weight of 12,000 pounds. Included in the castings are many aluminum tiles for the coping, which will average 50 pounds each, aluminum doors and door frames, an aluminum ladder, and braces for a huge semi-circular flower trough which will be constructed of sheet aluminum.

One of the best illustrations of the use of aluminum castings for ornamental architectural decoration is in the construction of the spire for a Pittsburgh church. Thus, Pittsburgh adds to its distinction by possessing the only church in the world which has a spire made of aluminum castings. This is the German Evangelical Protestant church at 620 Smithfield street, shown in Fig. 1. It is French Gothic style and was designed by H. Hornbostel, a well known architect.

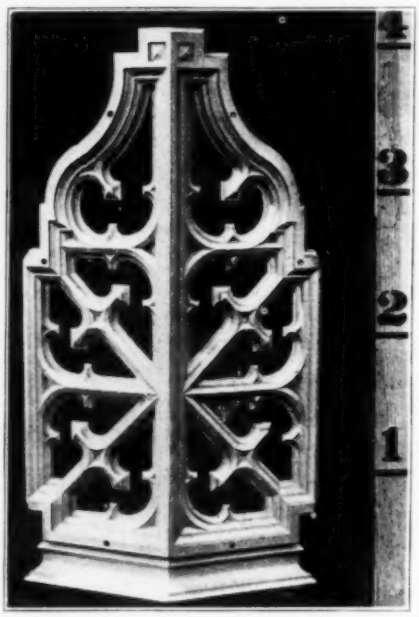


Fig. 4—Two Castings Form the Corner Pieces for the Banding on the Stone Tower

A total of 221 castings are used in the construction of this new innovation in church spires which stands out so strikingly against Pittsburgh's skyline. Mr. Hornbostel is an enthusiastic proponent of the use of aluminum castings in building construction and predicts the time is not far distant when they will find even greater application than in this striking edifice towering 259 feet above the street level.

The octagonal spire is 80 feet in height and rests on a concrete base 179 feet above the street. Crosses on the four sides, illuminated by electric lights at night, are made of duralumin sheets. Pure aluminum sheets were used for the hips, gutters, flashings and roof of the small tower to the right of the spire shown in Fig. 1.

Patterns for the castings used in the church steeple were made by the General Model & Pattern Co., Cleveland. It easily may be seen from the numerous illustrations of the various castings that the patterns required exacting care to give the resultant effect in the finished castings.

The spire of the Pittsburgh church is made of aluminum castings weighing 7434 pounds. The banding which is used to face the limestone top of the tower upon which the spire rests is of similar construction. The cresting which tops the gable shown to the right in Fig. 1 also is made of aluminum castings.

The base of the spire shown in Fig. 5 is composed of 8 panels and an equal number of corner posts. The panels are 9 feet long and to obtain an even lift from the sand the pattern was made in two sections dividing vertically through the center of the circular design in the middle of the piece. The posts are made up of seven castings which are bolted together to form a four winged post. As may be seen in the post on the left of Fig. 5 one casting has two wings made in one piece. The other two wings are cast separately. The remaining pieces are used at the top to form the cross-effect. Dry sand

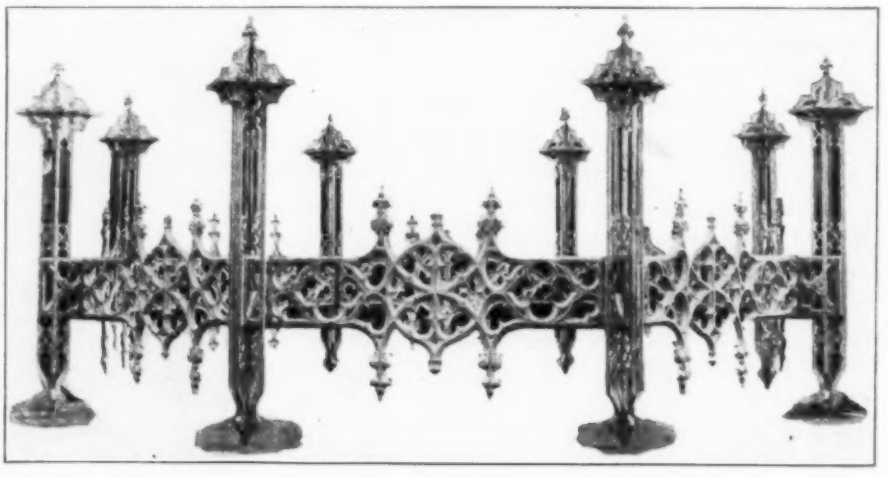


Fig. 5—An Assembly of the Castings Forming the Lower Part of the Spire. Note the Beauty of the Design

cores were used to form the various carved sections that can be seen on the points on either side of the center of the panel and at the tops of the corner posts.

As may be seen in Fig. 2, the spire is constructed of alternate panels. Fig. 3 shows a single panel which is one of the lower ones. It is 9 feet high and 7 feet wide. At the top and bottom of the panel are projections which extend into the vacancy left by alternating the panels. Other castings bearing the same design as the projections are bolted on either side of the panels. These four projections then form the design of the alternate panel. Dry sand cores also were used on these castings to form the carved sections at the tips of the projecting parts. Due to the large size of the panels, the pattern was divided into four sections on the vertical and horizontal center lines.

The banding which caps the limestone tower as shown in Fig. 10, is composed of 24 castings. The center panel of each octagonal section comprises one casting which is bolted to a corner section, one on each side. The panel section is shown in detail in Fig. 7 and the corner sections in Fig. 4. The panel sections are 5½ feet long and about 2 feet wide. The corner sections are four feet high and one foot in width. Each of these castings were made in one piece. Each side of the octagonal banding weighs 100 pounds including the corner pieces. The panels alone weigh 55 pounds each.

Fig. 6 shows a close-up view of the crest which surmounts the gable of the church. This crest is 40½ feet long and is composed of 16 castings which form the 8 filigree panels, 7 castings which form the intermediate posts and 2 castings for the end posts. Two castings which form each filigree panel weigh 159 pounds. The fleur-de-lis design castings used in the

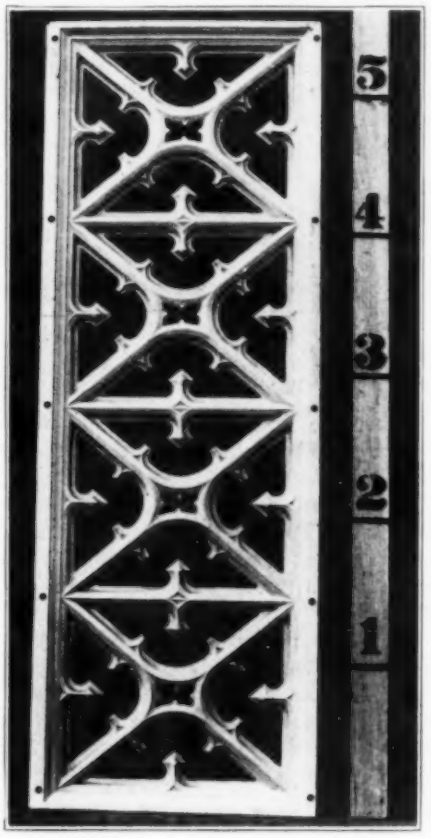


Fig. 7—One of the Panels Used in Banding the Top of the Tower

center of the bottom bar of each filigree panel are cast separately as are the scroll sections which are used to finish off the lower parts of the end posts.

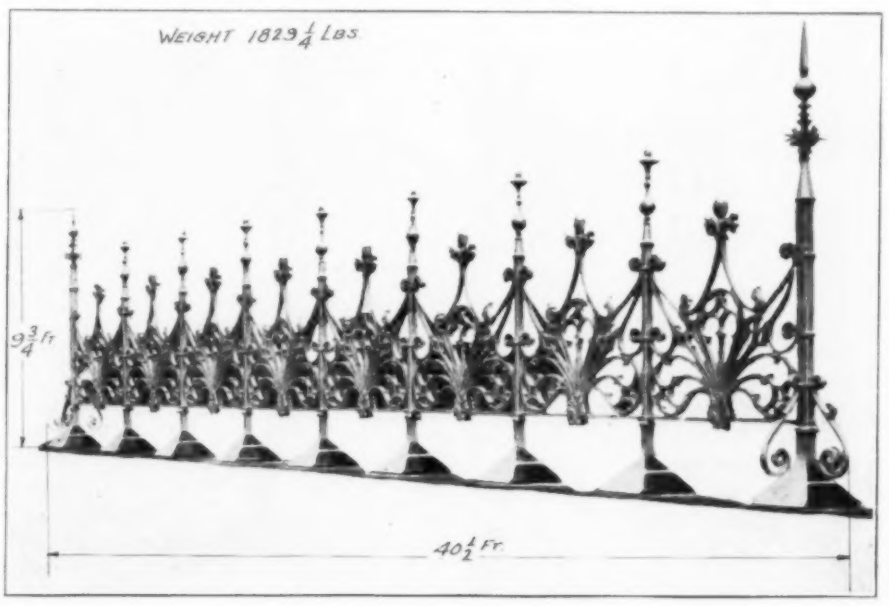


Fig. 6—The Cresting on the Gable is Over 40 Feet Long and 9 Feet High. Two Castings Form Each Panel

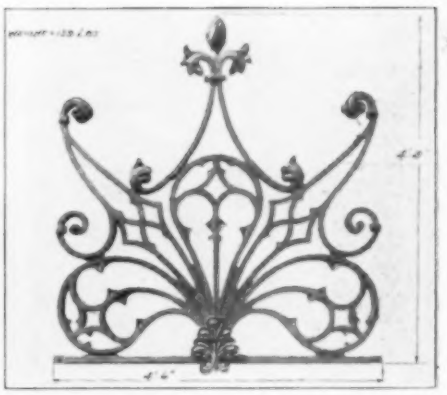


Fig. 8—A Close Up View of the Two Castings that Form the Filigree Panels in the Gable Cresting

The end posts of the crest, one of which is shown in Fig. 12, are 9¾ feet high with a 4-inch cross section for the post proper and weigh 107 pounds each. When all castings are assembled, the crest is 40½ feet long and weighs 1829 pounds. The extreme tip of the spire is a single casting weighing 201 pounds.

An excellent idea of the manner in which the spire was erected may be gained from Fig. 9. This shows the skeleton steel frame work on which the various castings were bolted to form the completed spire. Galvanized steel bolts were used. The holes in the castings were drilled slightly oversize and filled with a mastic putty which was forced out as the bolt was drawn up. This was an extra precaution observed to prevent any possible electrolytic corrosion between the two metals. The tip section and the first row of panels are in place.

The steel framework was erected by the McClintic-Marshall Co., Pittsburgh. To show the accuracy of molding it might be stated that before the castings were put on the spire, they were assembled in the shops of the McClintic-Marshall Co. Due to the extreme height of the spire which would necessitate a great outlay of time and money in constructing a temporary framework, the complete spire was assembled in a horizontal position.

All the castings were made from an alloy containing 5 per cent silicon and 95 per cent aluminum, manufactured by the Aluminum Co. of America. This alloy has a minimum tensile strength of 17,000 pounds and an elongation in 2 inches of 3 per cent. It is one of the new silicon alloys that has been introduced into the foundry in the past few years. It is said to possess good casting properties. It is fluid and is well adapted for castings of thin sections. The alloy also possesses good corrosion resistance properties. Due to the

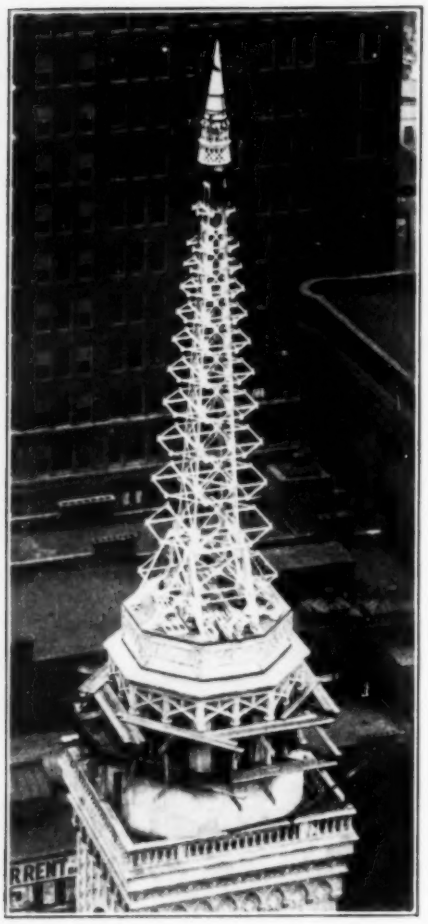


Fig. 9—Steel Skeleton Framework to Which the Castings Were Fastened

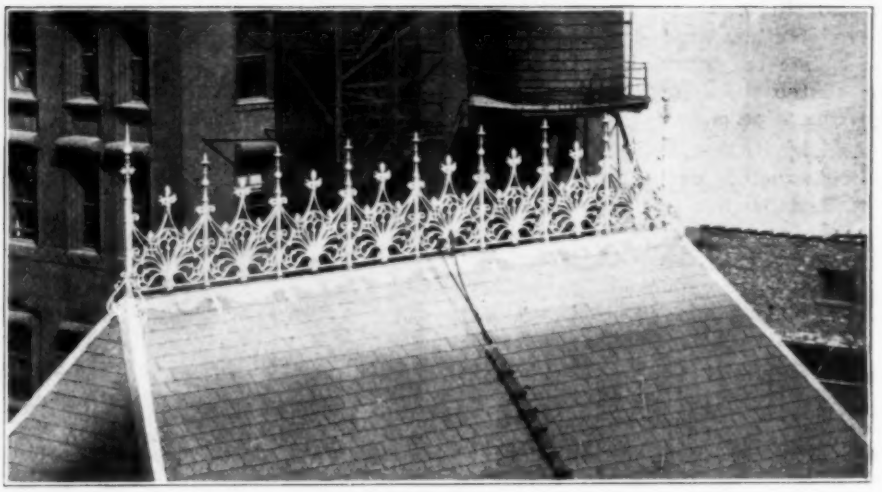


Fig. 11—A View of the Crest After It Was Mounted in Position on the Gable Roof of the Church Proper

ductility of the alloy, castings may be straightened if they become warped.

The castings for the spire were cast in green sand. As mentioned previously, some dry sand cores were used on carved sections that had underlays. The usual precautions of gating, risering and ramming properly as mentioned were observed. Ordinarily, a contraction factor of 5/32-inch per foot is allowed in aluminum but in this instance the factor was lowered to ⅛-inch per foot with excellent results.

The metal is melted in oil fired furnaces. The melting room contains 50 furnaces, which are tilting type, iron pot furnaces with capacities of 400 pounds and two large reverberatory type furnaces each with a capacity of 30,000 pounds. All the furnaces are made by the company. The large furnaces are used for making alloys and for supplying metal for large castings.

Thermocouples are inserted in the bath of molten metal in each furnace. Leads from the thermocouples are connected to switches in a central pyrometer house which contains the indicators. An attendant in the pyrometer house checks the temperature of the melting metal from time to time and when it reaches the proper temperature, the melter is warned by a signal light.

The molten metal is poured into crucibles which are transported to the foundry on two wheeled buggies. At various stations around the foundry are placed pyrometers, and each ladle of metal is checked for temperature before pouring.

The foundry building is constructed of steel and brick, exceedingly well-lighted by skylights. Electric lights placed well toward the roof distribute the light evenly for night operation.

(*Concluded on Page* 321)

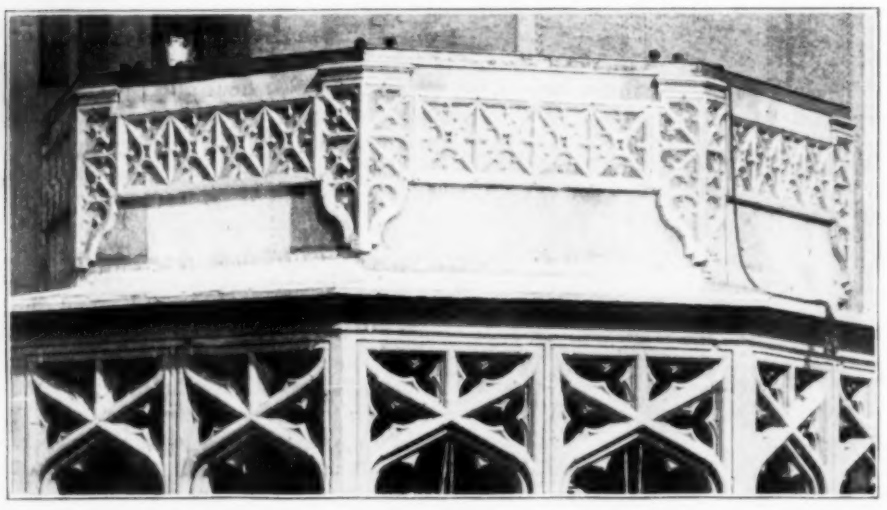


Fig. 10—Showing the Banding in Place on the Limestone Tower Upon Which the Spire Was Erected Later

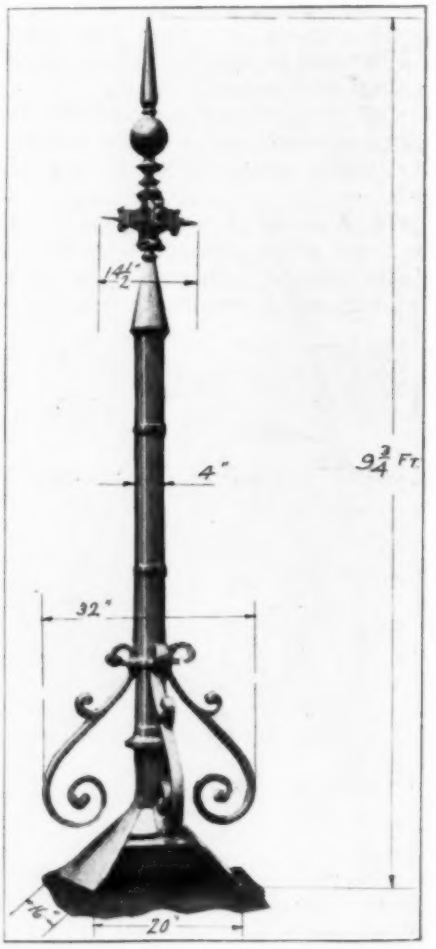


Fig. 12—An End Post Used on the Gable Cresting

Prevent Castings from *Warping*

Several Members of a Local Foundryman's Association Supply Theories and Remedies for the Cause and Cure of Warped Castings

RECENT experience of the secretary of a district foundrymen's association to secure data on the subject of warped castings would seem to indicate that a considerable amount of uncertainty still exists on several phases of the subject. Practical unanimity prevails in the opinion that danger of warpage always is present in long, thin, light castings. Up to the present, apparently no universal method has been developed for preventing this phenomenon. Concensus of available opinion seems to be that each type of casting must receive individual treatment. Comments from five foundrymen are presented under the headings, *A*, *B*, *C*, *D*, and *E*.

(*A*) A considerable part of our work is along the ornamental line and includes lamp standards, brackets and columns. The castings are light in section, not over 5/16-inch, from 12 to 48 inches in length and a wide variety of styles.

We attribute part of our success to the fact that we use heavy gage steel flasks that hold their shape. However, the principal factor in the prevention of warpage is the manner in which the mold is rammed. For example if a casting shows a tendency to dip down at the ends and hump in the center, the ends of the mold are rammed hardest in the drag, while the center is rammed hardest in the cope. Where the tendency is in the opposite direction, the procedure is reversed. If for any reason the casting must be shaken out hot, it is supported on edge instead of being left flat on the sand, either bare on one side or only partly covered.

We also make doors and frames for safes ranging in size from 6 x 16 x 24 inches to 7 x 40 x 82 inches with an average metal thickness of 3/16-inches. The molds are made in channel steel flasks. The sand is rammed hard on the inside of the pattern and the mold also is gated on the inside. Various numbers of hand ladles, depending on the size of the casting, are employed to pour the iron. The castings are not shaken out until they are cold. We have no trouble keeping them straight. Doors are handled in the same manner and must be straight to form an air tight fit in the frame and thus resist the efforts of the burgling fraternity who may seek to introduce water or nitroglycerine between the door and the frame.

Castings are poured from a fairly soft iron mixture with silicon ranging from 2.25 to 2.75 per cent. The daily production varies from 18 small to seven large frames. Loss runs from 2 to 3 per cent.

Old-Time Remedy

(*B*) My reply will be of little practical value since it only can be applied by those who already have practical shop experience and therefore presumably are familiar with the practice. We follow the line of least resistance. Where we find a casting warping, we bow the pattern in the opposite direction. The amount is based on experience. Sometimes, the warpage is caused by shaking the castings out too hot. In these instances the enthusiasm of the shake-out gang is restrained so that the castings are allowed to remain in the mold until they become cold.

(*C*) Warpage in lengthy pieces of cast iron of unequal section is caused by physical changes which occur while the metal is passing from the fluid to the solid state. It is quite generally known that an expansion takes place in the iron at the moment of solidification and, after the metal has reached a solid state, shrinkage occurs in further cooling. In a casting with unequal section the thin parts will solidify first. While these parts are shrinking the heavier parts which are slower in solidifying actually are expanding. This simultaneous action of two opposite tendencies, shrinkage in one part and expansion in another, causes warpage.

Composition of the iron is only a minor factor so far as warpage is concerned. Iron with high silicon and phosphorus and low sulphur and manganese will warp to a less extent under similar conditions than iron of a harder composition.

Heat conducting capacity of the mold perhaps is the most important factor to be considered. If it was possible for the entire casting to cool all over at the same speed it is possible that warpage would be prevented. There is no means of controlling the cooling in sand alone, but a method might be developed for the distribution of chills on the heavier sections to bring about a fairly uniform rate of cooling for the entire casting.

(*D*) Composition of the iron is responsible in many cases for the warping of castings. Another prolific reason for warped castings is the habit of taking them from the sand too soon after they are poured.

(*E*) I do not think there is a definite answer to the warping problem. Anything is possible even if it is not probable. Possibly at some time and place some person has figured out a set of rules for anticipating the warpage, but if so I never heard of it.

According to my experience the foundryman has nothing to guide him but the faculty of intuition developed through many years of close observation.

A baseball pitcher can land a ball where he wants it. He cannot transmit the knowledge to another man so that the second man can duplicate the feat immediately. The second man has to learn for himself how to coordinate the action of the various muscles involved. An experienced foundryman can look at a pattern and judge pretty closely whether or not the casting will warp if molded with proper care. Also he can take certain precautions to prevent it from warping under certain conditions. This kind of knowledge is one of the kinks or tricks of the trade and like learning to play a bass drum, only can be acquired through time and experience.

Removes Headquarters

The Audit Bureau of Circulations of which THE FOUNDRY is a member, now is engaged in removing its headquarters from the Century building, Chicago to the Builders building. The bureau is a co-operative organization to which practically all the worthwhile publications of the United States and Canada belong and through which they report to the advertising world the size and distribution of their circulations. In addition to the publisher members, most of the great national advertisers and advertising agencies also are members. The new offices will allow the organization to house its printing plant, mimeograph department and general office on one floor and facilitate the many departmental activities. O. C. Harn is managing director of the Audit Bureau of Circulation.

High Quality Cast Iron
Produced by Superheating-II

By Dr. E. Piwowarsky

IN HIS investigations F. Meyer used four groups of experiments arranged in series. These differed from each other in the type of furnace used, the metal mixture, the quantity of metal involved and the crucible material.

Altogether Meyer ran 14 series of experiments. One of these he deemed unreliable due to inaccurate temperature determinations and excessive carbon reductions and increases. Of the remaining 13 series only two were contrary to the author's observations while 11 confirmed the presence of a critical point of carbide transformation at 2640 degrees Fahr. Aside from its scientific value, the existence of this critical temperature will indicate the optimum region of superheating necessary to improve the quality of cast iron.

At the present time the author believes that Koerber's theory, *Stahl und Eisen*, 1915, that the increasing solution of mechanically mixed graphite particles and the increasing dissociation of molecular iron carbide is active in promoting inverted curves, is justified. Furthermore, the gas phase evidently is effective since when the author conducted melts in vacuum, the carbide reversal rarely occurred.

Haneman, *Monatshefte des Berliner Bezirkvereins deutscher Ingenieure*, April 1, 1926, has been able to verify that for moderate ranges of superheat, crystallization brought about by nuclei of undissolved carbon has a potent effect upon the size of the graphite particles due to the retardation of the setting process below normal freezing point. From numerous observations and investigations the author has concluded that the use of gray-fracture pig iron in the foundry industry retards the complete solution of graphite when melting under conditions of moderate ranges of superheat.

Suggests Simple Process

IN THIS, the second and concluding section of the article abstracted from Dr. Piwowarsky's paper, other investigations are cited to bear out his theory on superheating cast iron. The author also suggests a simple method for obtaining high quality cast iron by melting quickly at high temperature, machine cast and preferably water-chilled pig iron. Several other investigations including the influence of steam and alloys are described.

Therefore the author has proposed a simple method for producing high test cast iron in which all pig irons including those with high silicon content are specified to be machine cast and if possible water chilled in addition. If the melting process in the cupola, air furnace or electric furnace is carried through with sufficient rapidity, nearly all the carbide will remain intact and go into solution in the melt. A result is obtained similar to that when molten iron is given an extended superheating.

Dissolved gases seem to act in the same manner as undissolved carbon content, and therefore, it would seem advantageous to subject highly superheated molten iron to a jolting or centrifugal process.

Use of higher pressures in steam engines and turbines necessitates employment of cast iron which does not grow under these conditions. For this reason the author has conducted investigations to bring out the influence of graphite formation and production operations on the iron upon its tendency to grow.

Experiments were performed using a universal differential dilatometer, designed in the metallurgical laboratory of the Institute of Technology of Aachen, with temperature oscillations from 750 to 1830 degrees Fahr. Each temperature oscillation, including heating and cooling, occupied two hours. Investigations on an iron with about 3.00 per cent carbon and 2.2 per cent silicon have shown that 25 oscillations in this temperature range in a vacuum brought practical cessa-

Table V

Various Data on Oscillation Experiment

	Melt No. 1	Melt No. 2	Melt No. 3	Preheated Mold to Dry Sand	Dry Sand Mold to Green Sand	Green Sand Mold to Chill Mold
Total carbon, per cent	2.99	2.98	2.85	2.85	2.87	2.90
Graphite, per cent	2.02	1.89	1.81	1.81	1.81	1.75
Silicon, per cent	2.18	2.28	2.40	....	2.40	....
Heated at, degrees Fahr.	2,300	2,590	2,895	....	....	....
Poured at, degrees Fahr.	2,280	2,280	2,280	....	....	....
Structure	Coarse	Fine	Fine	Fine	Fine	Extremely Fine
Hardness before heating	....	....	....	180	179	197
Growth in per cent after oscillations:						
1 and 3, in air	1.70	1.79	2.00	1.80	2.00	1.98
4 and 28 in vacuum	3.71	3.99	3.20	4.00	3.20	2.80
29 and 31 in air	0.49	0.79	0.41	0.60	0.41	0.69
31 and 33 in N^2	0.10	0.00	0.11	....	....	....
Total growth	6.10	6.57	5.72	6.40	5.61	5.47
Hardness after heating	180	175	185	....	....	....
Specific gravity	7.364	6.972	7.219	....	....	....
Composition after oscillation (33 and 31, respectively):						
Total carbon, per cent	2.69	2.71	2.69	2.68	2.71	2.69
Graphite, per cent	2.69	2.71	2.69	2.68	2.71	2.69

tion of growth since subsequent oscillations in a nitrogen atmosphere resulted in no further enlargement. However, as soon as air was allowed to enter growing commenced.

Fig. 4 shows the curves from irons that had almost identical compositions. The compositions being given in melts 1, 2 and 3 in Table V. The dilatometer test pieces were taken from the upper end of the mold. Their structural conditions would correspond to the upper horizontal series in Fig. 2. If the values of the annealing curve are disregarded and the first three heatings (possible imperfections in the orientation of the apparatus became compensated during the taking of the first few curves), it may be noted from Table V that:

The amount of the changes in length after treating the melts at 2910 degrees Fahr. was less in all cases than the changes of the heats treated at only 2280 degrees Fahr.

That the largest growth values presented themselves when treatment was given the melts at medium temperatures of about 2595 degrees Fahr.

Discussion of Results

Therefore, it would seem as if the natural tendency of cast iron to grow less as the graphite particles become smaller and the superheating temperatures rise, was confronted by an opposing factor which developed when treatment was had in the medium temperature range. This deleterious influence may be attributed to the decrease in density of the material, resulting from the increased evolution of gases. This may be seen from the values for specific gravity in Table V.

Density determinations made on the test series poured at 2300 degrees Fahr. gave the values tabulated in Table VI which seems to indicate that as the rate of cooling decreases the density drops. It may not be amiss to connect this phenomenon with the bettered opportunity for the evolution of gases as the rate of cooling is retarded.

To test the influence of abnormal superheating on volume constancy and resistance to corrosion of cylinder iron, the author obtained five test pieces from foundries. Tests were carried on through the same temperature range as mentioned previously. Table VII gives the plant data. The graphite structures are shown in Fig. 5 and the oscillation data in Fig. 6.

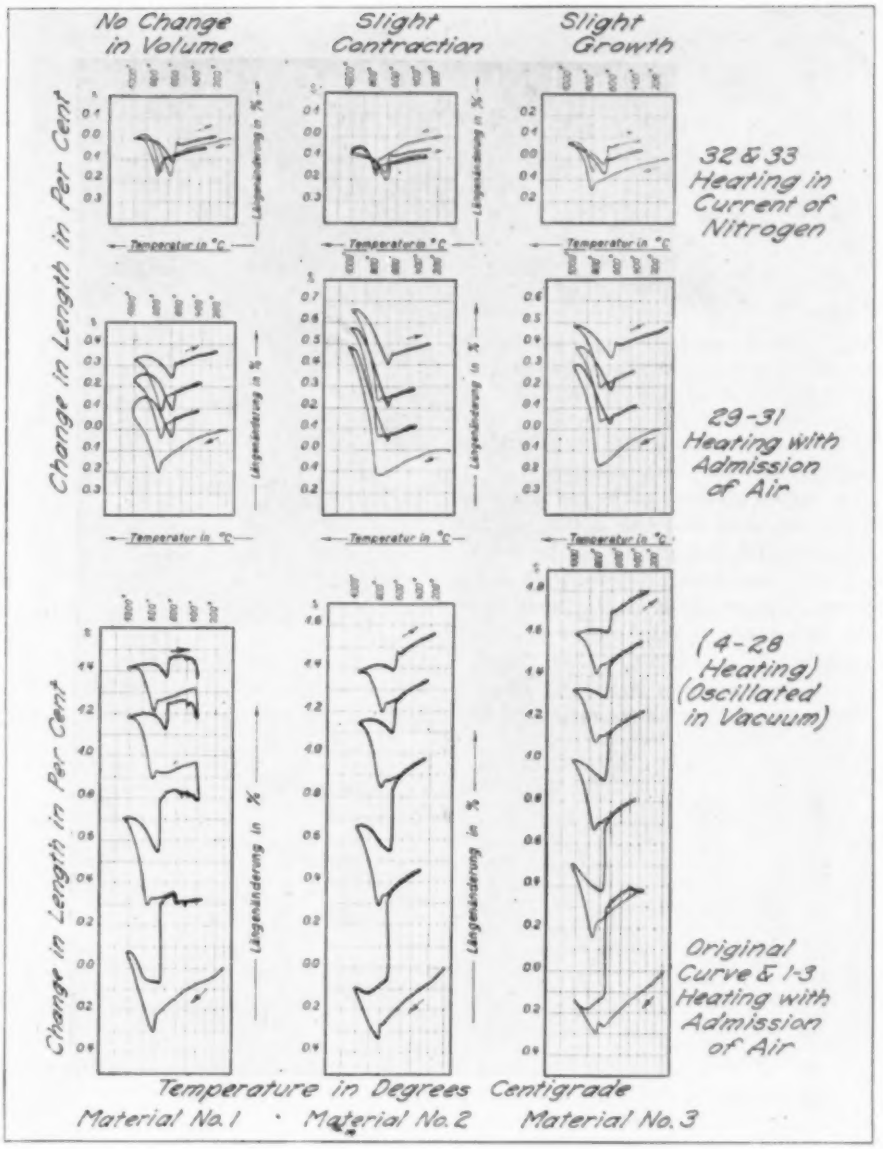

No Change in Volume
Slight Contraction
Slight Growth
Change in Length in Per Cent
32 & 33 Heating in Current of Nitrogen
29-31 Heating with Admission of Air
(4-28 Heating) (Oscillated in Vacuum)
Original Curve & 1-3 Heating with Admission of Air
Temperature in Degrees Centigrade
Material No. 1
Material No. 2
Material No. 3

FIG. 4—GROWTH CURVES FOR A SILICON-RICH CAST IRON SUPERHEATED AT VARIOUS TEMPERATURES

Coarsely graphitic cupola irons of plants *A* and *B*, which ran 1.50 and 1.85 per cent silicon grew markedly. The greatly superheated, high-test cast iron of plant *B* also containing 1.85 silicon but with a better graphitic structure grew to only one-half the extent. The best results were obtained from superheated air furnace iron. This was made at plant *D* and contained 1.80 per cent silicon. Iron from plant *C* which was low in total carbon with finely divided graphite but with silicon of 2.00 per cent grew slowly. However, this growth amounted to considerable at the close of the oscillation tests.

As an example of the influence of increased density in hindering carbide disintegration the following is given: An 11-pound melt of Swedish charcoal iron was alloyed with about 3.5 per cent silicon and then superheated to 2885 degrees Fahr. It was kept at this temperature for 15 minutes and then allowed to cool until the first indications of setting metal appeared on the surface. The melt was then transferred to a furnace heated to 2010 degrees Fahr. and allowed to remain 1½ hours with a gradual lowering of the temperature

Table VI

Density Determinations on Test Series

Transition from	Graphitic structure	Total carbon	Graphite	Silicon	Specific gravity	Hardness No.*
Preheated to dry sand mold	Coarse	2.99	2.02	2.20	7.364	175-181
Dry sand to green sand mold	Fine	3.02	1.97	2.18	7.229	173-180
Green sand mold to chill mold....	Extremely fine	3.01	1.89	2.18	7.194	195-198

*Tested for hardness on upper and lower surfaces of cylindrical test piece.

FIG. 5—STRUCTURE OF FIVE TESTED IRONS AS ORIGINALLY RECEIVED. NOT ETCHED. X100

to 1920 degrees. Final solidification was affected in the atmosphere

In spite of the high carbon and silicon content, and the action of the nuclei of kish-like graphite, the solidified iron contained considerable ledeburite. An analysis of the melt gave the following: Total carbon, 3.90; graphite, 2.24; silicon, 3.25. Structure of the metal is shown in Fig. 7.

In connection with a series of investigations, *Die Giesserei*, July 3, 1926, on the behavior of various classes of cast iron held under steam at 570, 660 and 840 degrees Fahr. for 75 hours, the author made observations that seem to fit into this subject to a certain extent. Fig. 8 gives average views of structures of 5 synthetic iron melts made in a crucible. The analyses are given in Table IX.

Apart from Melt V which carries chromium and set with practically a white fracture, the less favorable graphitic development of high silicon Melt I and the high sulphur Melt IV as against Melts II and III will be recognized. The graphite lamellae in IV while appearing rather thin make up for it by being longer and well interlaced similar to Melt I, but are more accessible to corrosive action. Entrance of steam was made more difficult in the case of the thick but shorter graphite lamellae of Melt II (low in silicon, phosphorus and sulphur) and III (rich in phosphorus but poor in silicon and sulphur). Table VII presents the most important values obtained from the various tests. From the preceding matter the following conclusions may be drawn:

A considerable surface oxidation accompanied with volume increase took place in all irons irrespective of their chemical composition.

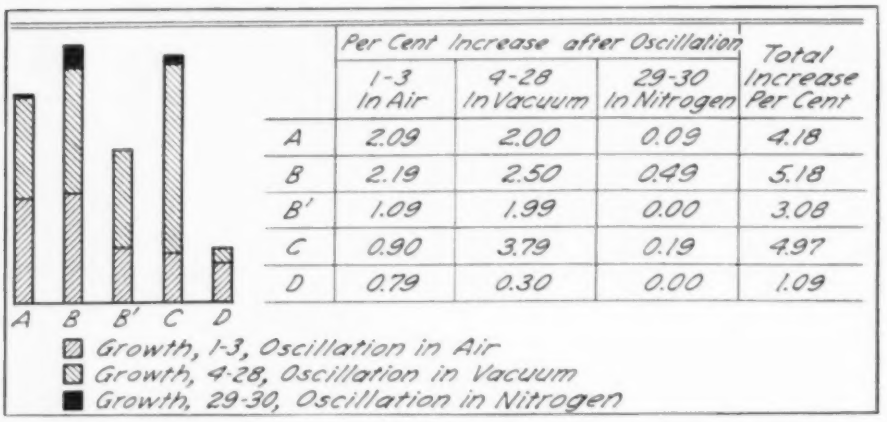
With steam at temperatures of 660 degrees Fahr. an appreciable oxidation of the heart of the metal took place only in the melts richer in silicon and having poorer graphite development.

With steam treatment at 840 degrees Fahr. the oxidation in the heart of the iron samples rich in silicon and sulphur (with poorer graphite development) was greatly increased while the heart of the lower silicon iron of Melts II and III (rich in phosphorus) remained practically free from oxide formation due to their better graphite development. The beneficial effect of dense structure is shown particularly in Melt V which contains chromium and set with a white fracture.

A much greater degree of carbide disintegration took place in the current of steam with some air admission at 570 to 840 degrees Fahr. than generally has been observed heretofore.

A loss of 10 to 15 per cent in total carbon is observed as the result of the steam treatment of cast irons.

Even though many single instances of observation regarding the behavior



	Per Cent Increase after Oscillation			Total Increase Per Cent
	1-3 In Air	4-28 In Vacuum	29-30 In Nitrogen	
A	2.09	2.00	0.09	4.18
B	2.19	2.50	0.49	5.18
B'	1.09	1.99	0.00	3.08
C	0.90	3.79	0.19	4.97
D	0.79	0.30	0.00	1.09

FIG. 6—RESULTS OF GROWTH EXPERIMENTS ON SAMPLES FROM COMMERCIAL FOUNDRIES

Table VII

Data on Specimens from Foundries

	Establishment A	B	B'	C	D
	Type of Iron: High Pressure Cylinder Castings	Piston Ring Castings	High Test Cylinder Castings	High Test Low Carbon C.I.	Quality Castings†
Analysis, as received, in per cent:					
Total carbon	3.02	3.02	3.02	2.38	2.70
Graphite	2.44	2.70	2.42	1.69	1.84
Silicon	1.50	1.85	1.85	2.00	1.80
Manganese	0.85	0.65	0.92	0.80	1.50
Phosphorus	0.43	0.57	0.07	0.14	0.04
Sulphur	0.16	0.12	0.09	0.13	0.02
Type of furnace used	Cupola Normal Melting	Cupola Normal Melting	Cupola Hot Melting	Cupola Highest Superheat	Air Furnace High Superheat
Bending strength, pounds per square inch	66,850	65,575	76,805	83,630	103,830
Deflection, in inches	0.472	0.512	0.394	0.315	0.236
Graphitic Structure	Long Flakes	Long Flakes	Short, Thin Flakes	Mostly Granular	Short Thick Flakes

†Synthetic cast iron.

of cast iron under steam service conditions exist, literature on the subject as yet is unfortunately inadequate and far from systematic. Nevertheless, the author's few observations along this line would indicate that it seems possible to produce a cast iron capable of resisting steam even at high temperatures. Such an iron will have to be made of a suitable composition based upon a systematic reduction in the size of the graphite particles contained, with full relief from occluded gases and a deoxidation of the melt.

As a consequence, this treatment will be chosen because better physical strengths of the material may be obtained and because castings can be produced free from strain and of constant volume. Only when strong solvents such as dilute acids, etc. were applied, the advantage due to a finer graphite structure was not marked.

In a comprehensive paper, *Stahl und Eisen*, Feb. 26, 1926, on the influence of nickel, chromium, aluminum, vanadium, tungsten, molybdenum and cobalt, the author has shown that the influence of special metals in cast iron will attain full value only when recourse is had to appropriate heat treatment such as annealing and beneficiation processes. Further, that it was illusory to expect an improvement possible in the pearlitic structure matrix as long as the problem of systematically increasing the fineness of the graphite particles had not been solved. At present with the systematic reduction in size of the graphite particles fully at our command, it would seem a proper time to renew investigations into the effect of alloying irons.

FIG. 7—MICROGRAPH OF SWEDISH CHARCOAL IRON SHOWING COARSE GRAPHITE NEEDLES AND PARTLY DECOMPOSED LEDEBURITE

Table VIII presents the results that some experimental melts of the author intended to bring out the influence of nickel-chromium additions. These additions were made synthetically and by the use of nickel-chromium bearing pig iron. Additions could not effect appreciable benefits when the irons already had been transformed to high test metals through abnormal superheating.

Of course, the few values in question cannot be considered as conclusive evidence, but they seem to substantiate the author's previous suppositions that apart possibly from resistance to abrasion, the influence of small percentages of beneficiating additions to ordinary cast iron hardly shows up in the resulting physical

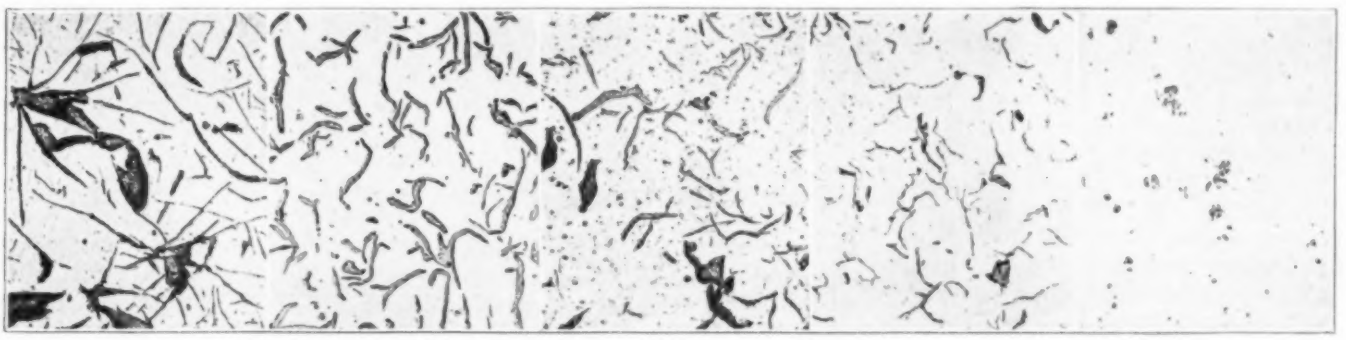


FIG. 8—SAMPLES TREATED WITH STEAM. UNETCHED, X100. MICROGRAPH *A* IS MELT I; *B* IS MELT H; *C* IS MELT III; *D* IS MELT IV, AND *E* IS MELT V

Table VIII

Experiments on Influence of Alloy Additions

	Melt No.								
	1	2	3	14	15	16	17	18	19
	Iron Mixture								
	A[1]	A	A	A	A	A	A	B[2]	B
Chemical composition, in per cent:									
Total carbon	2.54	2.30	2.20	3.45	3.40	2.59	2.56	3.02	2.00
Graphite	2.02	1.65	1.28	2.71	2.65	1.79	1.79	1.91	0.99
Silicon	2.46	2.64	2.35	1.92	1.76	2.32	2.02	1.64	1.84
Manganese	1.06	1.40	1.19	....	....	....	....	....	....
Phosphorus	0.18	0.14	0.16	....	....	....	....	....	....
Nickel	....	0.27	0.71	....	1.02	1.01	1.18	0.82	0.82
Chromium	....	0.85	1.40	....	0.34	0.30	0.29	0.08	0.06
Bending strength, pounds per square inch	87,185	100,985	88,180	49,780	62,580	96,715	96,715	71,115	52,625
Deflection, in inches	0.433	0.354	0.315	0.433	0.866	0.866	0.335	0.453	0.335
Compression strength, pounds per square inch	163,565	176,365	184,900	n. o.	n. o.	n. o.	n. o.	n. o.	n. o.
Tensile strength, pounds per square inch	44,230	50,450	44,945	25,500	27,025	46,935	39,825	35,555	25,500
Impact strength, work in foot pounds	10.85	7.23	8.68	n. o.	n. o.	n. o.	n. o.	n. o.	n. o.
Hardness No.	179	223	245	162	188	222	247	216	234
Number continuous blows	n. o.	n. o.	n. o.	814	1,659	15,156	4,771	1,661	87
Temperature data—melting and pouring	(*)	(*)	(*)	(†)	(†)	(†)	(†)	(‡)	(‡)

[1] Swedish charcoal iron + scrap + synthetic nickel-chromium composition iron.
[2] Swedish charcoal iron + scrap + nickel- chromium bearing pig iron.
n. o. Means not observed.
*Heated to about 2,730 degrees Fahr.; poured at 2,640 degrees Fahr., in dry-sand molds.
†Heated to 2,910 degrees Fahr.; poured at 2,550 degrees Fahr., in dry-sand molds.
‡Heated to 2,910 degrees Fahr.; poured at 2,640 degrees Fahr., in dry-sand molds.

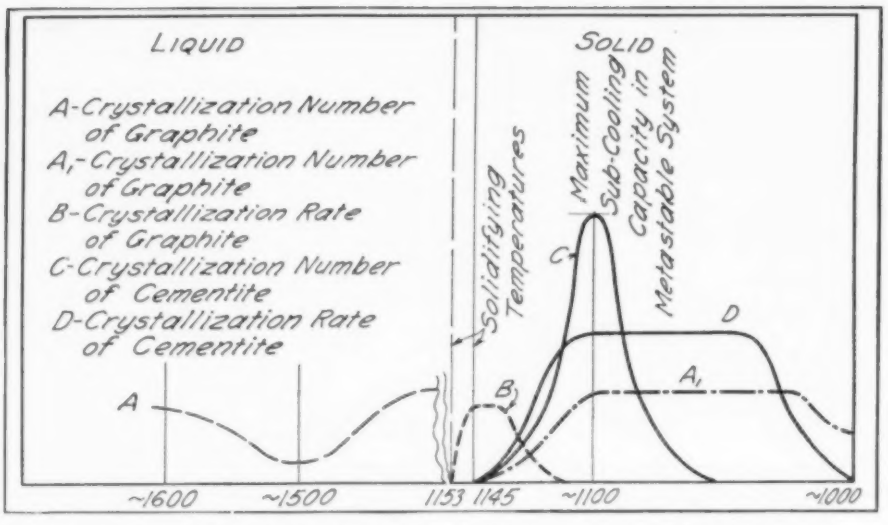


FIG. 9—CRYSTALLIZATION DIAGRAM CONSTRUCTED FROM VARIOUS DATA

properties. They only attain full value when an additional adequate heat treatment has been given the metal, just as we may observe in the case of special steels.

None-the-less, it is desirable that investigations into the further improvement of high test cast irons should continue so that all the properties in the material may be brought to light. This particularly, because in addition to the competition of steel castings, gray iron will have competitors in the form of the light metal alloys. These light alloys have developed strengths up to 56,890 pounds per square inch with 10 per cent elongation.

As the concluding part of this paper, the author would like to point out the crystallization diagram of cast iron which he has constructed upon the basis of well known investigations such as those of Von Ruer and his collaborators as well as his own. Naturally their value is only qualitative since he has not undertaken to measure the absolute size of the nuclei as well as the crystal formation. The explanation and application of this information will be patent to every metallurgist.

The absorption of the nuclei by the molten metal when it is abnormally superheated is a deduction that the author made from his observations and he did not differentiate between the finely divided mechanically dispersed *seeds* and spontaneously formed nuclei of graphite because of the processes dissociation involved.

Furthermore it should not be inferred from the diagram that he is an unconditional adherent of the double diagram theory (iron-carbon i. e. iron carbide) because the expressions, "number of nuclei" and the "rate of crystallization," are used. All we have to do it to replace the expression "rate of graphite crystallization" (line *B* in diagram) by "rate of dissociation of the carbide" and we are in accord with the adherents of the single diagram. In such an event the number of nuclei of graphite (A1 in Fig. 9) must be understood to mean the disintegration of the carbide.

A. F. A. Committee Plans Study of Iron

Need for organized research in cast iron fields was discussed at a meeting of the Cast Iron committee of the American Foundrymen's association held in Philadelphia on March 16. As a result of the meeting, recommendations were made to the American Foundrymen's association which involve a comprehensive study of the cast iron problems. The committee recommended that a complete bibliography of the existing literature of cast iron be prepared. This bibliography will cover the foreign as well as American publications and when finished the articles will be classified under various sub-headings. Following the preparation of this bibliography the committee will select all articles of value and summarize the information under each sub-division. From this summary the committee will formulate a research program to furnish information when it is shown to be lacking.

In addition to the above activity, the committee is endeavoring to complete arrangements for an immediate investigations of the effect on the quality of pig iron of the use of borings and turnings in blast furnaces. The need for this investigation recently has been emphasized by the publication of divergent views. This investigation will be discussed at the conference on pig iron qualities to be held at the Chicago convention of the association the week of June 6. This conference is to be held for the purpose of interesting pig iron producers and users in bringing out any definite information on the effect of scrap in the blast furnace and of other factors affecting the quality of pig iron.

Pistons Show Gas Holes Around the Rim

Question: We are having considerable trouble with our larger pistons which are cast with the open end up. The core is provided with a shoulder which supports it in the proper position in the mold and also serves as a cover on the top. Our smaller pistons are poured through a ring gate with branches entering the mold at several points, but the large piston is poured through a single runner. We have practically no loss on the smaller pistons, but on the large piston the loss is considerable owing to gas holes around the top rim. Our piston mixture is made up of malleable bessemer 60 per cent; steel scrap 10 per cent and the remainder is made up either of our own return scrap, or a good quality of machine scrap. In our 24-inch cupola we use 700-pound charges with a coke ratio of 1 to 9 and pour our light cylinders and pistons from the first few charges. We add 7 pounds 50-per cent ferrosilicon to each charge to prevent chilling the thin sections.

Answer: Your trouble may be due to one or several of many causes, but from the details submitted we are inclined to the opinion that your cores

Table IX

Analyses of Melts Used in Experiments

	Melt I	Melt II	Melt III	Melt IV	Melt V
			Per cent		
Carbon	3.55	3.04	2.89	2.98	3.42
Graphite	2.78	2.03	1.73	1.64	0.06
Silicon	2.13	1.08	0.97	1.14	1.00
Manganese	0.50	0.43	0.46	0.47	0.48
Sulphur	0.03	0.03	0.03	0.12	0.03
Phophorus	Sp.	Sp.	0.63	Sp.	Sp.
Chromium	.....	.....	.....	.....	1.12

are responsible. Cold iron will produce gas holes, so will oxidized iron and holes produced by steam will be found in castings made in wet sand or sand that is rammed too hard. Following the process of elimination it is apparent that your iron is not cold or oxidized, if it was your small pistons would show the effects. The same holds true for the condition of your sand. It is quite probable that your cores are too hard and the iron does not lie quietly against them. You may easily determine this point by making a core without any shoulder, set it on chaplets in the bottom of the mold, pour the mold *open* so that you may observe the action of the rising iron. If it bubbles or kicks on the way up it will indicate that the vent is not escaping freely through its proper channels.

The character of your sand, kind of binder employed and the style of corebox in use will determine what steps are necessary to produce satisfactory cores. It may be that your materials are of the best, but your cores are not dried sufficiently. Practically any core binder will make satisfactory piston cores if it is used in proper proportion and if the cores are dried thoroughly and conversely, no binder, or no mixture will make suitable cores if these fundamental factors are not observed. In your case we should suggest ramming a plug in the center of the piston core so that the finished core should merely be a shell. In this manner you save a certain amount of sand and also insure that the vent will escape freely through the inside instead of bubbling through the molten iron to cause the previously mentioned holes.

Britain Displays Industrial Products

THE Birmingham section of the British Industries Fair, Feb. 21 to March 4, was the eighth of the series and the largest exhibition of its kind ever held in the provinces of Britain. Buyers from 34 countries visited the fair, the representatives coming from Europe, British Dominions, Argentine, Chile, Iceland and China. Buildings covered an area of about 6 acres. Approximately 130,000 square feet was taken up by booths which numbered 600 as compared with 400 last year.

Nonferrous metals were exhibited in great variety of shape and size. Special alloys also were a feature. Brass and copper tubes and pressings and stampings are prominent. Stainless steel for a variety of purposes was much in evidence in the form of forgings, castings, bar, wire, sheet, foil, etc., and the finished articles covering the whole range of engineering and industrial uses of the corrosion-resisting materials.

An exhibit arranged by the Association of Drop Forgers and Stampers represented work of the leading drop forging firms in the country. The demand for forgings is now overtaking the supply and many manufacturers are making plant extensions.

The engineering section was agreed to be the finest since the inauguration of the fair included oil and gas engines, magnetic separators, conveying machinery, etc. Much of the equipment was operating. In the steam power section the principal feature was a modern boiler house, a co-operative exhibit in which a part was taken by over 30 of the leading engineering firms. The boiler house had two boilers, one of water-tube type equipped for powdered fuel firing and the other of the Lancashire type provided with mechanical stokers and accessories. In the engine room was a turbogenerator, a geared turbine, a reciprocating set for rope driving and a second vertical set for generating electricity.

The Pneulec Co. Ltd. of Smethwick, near Birmingham, gave a practical demonstration of its sand mixing machine made by arrangement with the Royer Foundry & Machine, Co., Wilkes-Barre, Pa. A new product was a tensile testing machine designed by F. J. Cook and G. B. Richards. It is of the hydraulic type, the working fluid being mineral oil. Test bars of usual shapes can be accommodated.

An electrical portable riddle made by the Adaptable Molding Machine Co. presented special features. It is suspended on beehive springs and the connecting rod of a similar type avoids the wear of bearings liable to friction by constant use of sand. For general foundry purposes the machine makes 120 oscillations per minute, and while the riddle moves 1 inch in the container it receives 240 impacts.

One of the new exhibits was a composite show by the Welsh Tinplate and Sheet Manufacturers. The Welsh tinplate and black plate industry is 180 years old and those who are engaged in it are alive to the value of showing the many uses to which it can be put, more particularly to food packing. N. Hingley & Sons, Ltd., of Dudley, well known for their wrought iron manufactures had a comprehensive exhibit showing iron for railway coach and wagon work, colliery work, chains and cables, structural work where corrosion is most active, and drop forgings for the general engineering and shipbuilding trades. T. E. Salter Ltd. of Tipton had an exhibition of grinding machines with dust collecting units for foundry use.

Many examples of drop forgings in iron and steel for the engineering, shipbuilding, agricultural, motor car and other industries were shown at the booth of Thomas Smith & Sons, Birmingham. A particularly interesting exhibit was a collection of drop forgings in Vickers duralumin, a white forgable metal which, although about one-third the weight of steel, is equal in tensile to mild steel, being extensively used for motor engine connecting rods, airplane components and other parts where strength and lightness are essential.

Organization Succeeds Malleable Group

The Malleable Iron institute, a trade organization recently incorporated with headquarters in the Union Trust building, Cleveland, will take over the work of the American Malleable Castings association. The institute is incorporated to provide a working business organization with a name more exactly descriptive of its purpose.

The objects of the institute are as follows: To foster and increase the use of malleable castings; to carry on laboratory and metallurgical research to improve the quality of malleable iron castings; to establish and maintain standards of quality; to exchange information on processes of manufacture; to establish cost accounting systems and to collect and compile statistics relative to the production of malleable iron.

The officers of the institute are president, F. L. Sivyer, Sivyer Steel Casting Co., Milwaukee; secretary and treasurer, Robert E. Belt, Union Trust building, Cleveland; consulting engineer in charge of the research laboratory, Enrique Touceda, Albany, N. Y. The business of the institute will be carried on by a board of directors through five standing committees.

Cast Bed Parts in Chills

All Metal Frames Are Made of Tubing and Rods Which Are Joined By Gray Iron Castings — Manufacturing Methods Are Simple

By Avery E. Granville

COMMON all-metal bed frames, which are made of tubing bent to shape, iron rods and angle iron, are held together at the joints by chilled gray iron castings of various shapes. While the size and shape of the castings used in this work differ considerably, the general processes of construction follow closely along the parallel lines. Since many beds of this type are built to sell at a low price, the manufacturing methods must be simple, cheap and capable of being followed by workmen who are not skilled mechanics but may be trained for this particular work in a short period of time.

Chills for the head and foot frames are carried on fixtures such as are shown in Fig. 1. These fixtures are trunnioned, as shown at *A*, Fig. 1, and are held in the horizontal position by rods fastened to the fixture as shown at *B*, so that work may be set in place or removed. Chills are made with as little machining or hand finishing as possible and are fastened to the cross members of the fixture by bolts or cap screws. The chills for the lower rod and the five vertical rods of the bed end are shown closed in Fig. 1. The runners of the chills are indicated at *C*.

The chill at the extreme left, located at the point where the casting connects the lower rod to the bed post, also is shown closed and the runner is indicated at *D*. The chill on the right side of the post is open. A close view of this frame with the bed frame removed and part of the chills open is shown in Fig. 2. A general idea of the construction and operation of the chills may be secured through a study of the chill at *D*.

The fixture in the pouring position with the bed frame in place is shown in Fig. 3. The two hinged bars hold the fixture upright while the iron is being poured into the chills.

A front view of a similar fixture is shown in Fig. 5. In that illustration, all of the chills, with the exception of those for the rail brackets are shown closed ready for pouring. In some cases the rail brackets are cast entirely around the bedposts. However, in the type of bed shown in Fig. 4, the rail brackets are held by metal which runs through the drilled holes at *E*, and connects with a pad or boss of metal on the inside of the bedpost.

This method of casting the bed rail brackets is illustrated further in Fig. 5. The two drilled holes are shown at *F*. A cast iron chill, similar to that shown at *G*, is placed on the inside of the post tubing and wedged tightly back of the two holes. When the metal is poured in the chill, it will run through the holes and form a pad on the inside of the pipe which holds the bracket in place securely. The dovetail on the bed post at *H* is formed by a loose piece or core which may be knocked out readily when the casting is removed from the chill.

Another view of the open chills is given in Fig. 6. The runners are indicated at *I*, *J* and *K*. The type of chill used in casting the rail bracket

Fig. 1 (Below)—The Fixtures for Bed Frames Are Held in the Horizontal Position by a Special Rod. Special Runners Are Provided

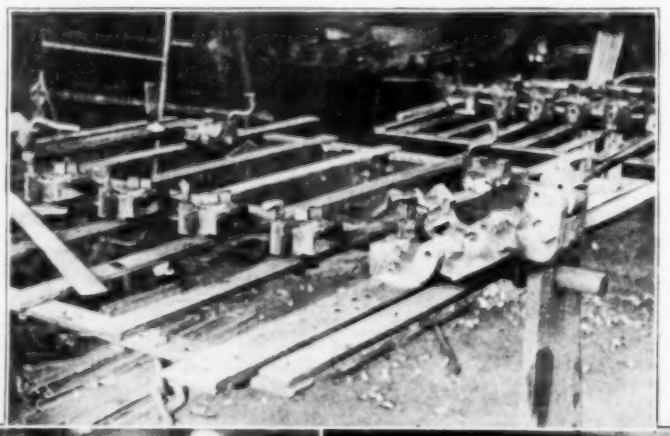
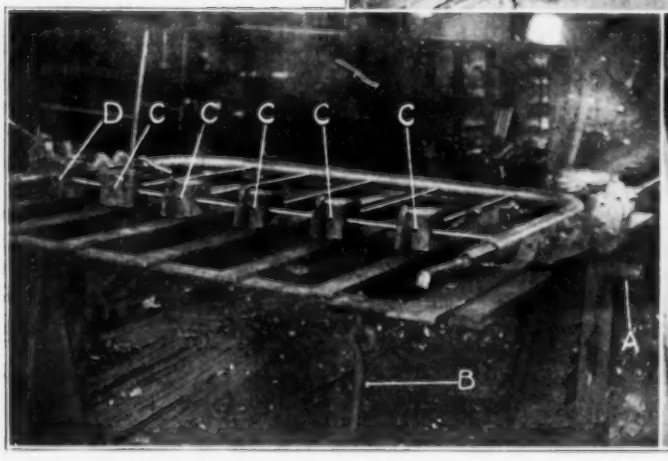
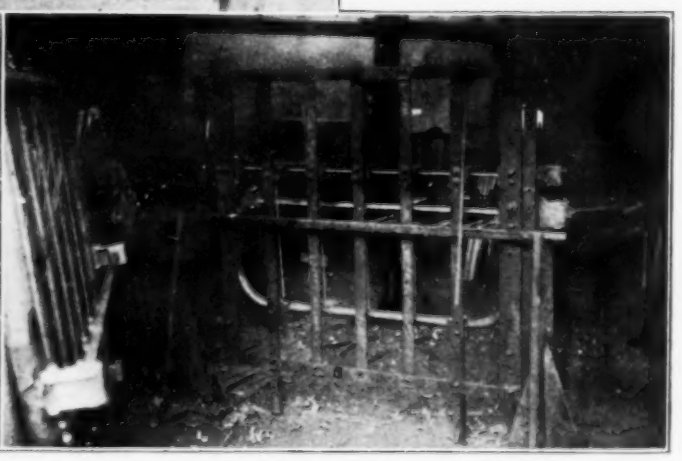


Fig. 2 (Left)—The Bed Frame Has Been Removed To Show the Construction of the Chills. Fig. 3 (Below) Fixture in the Pouring Position





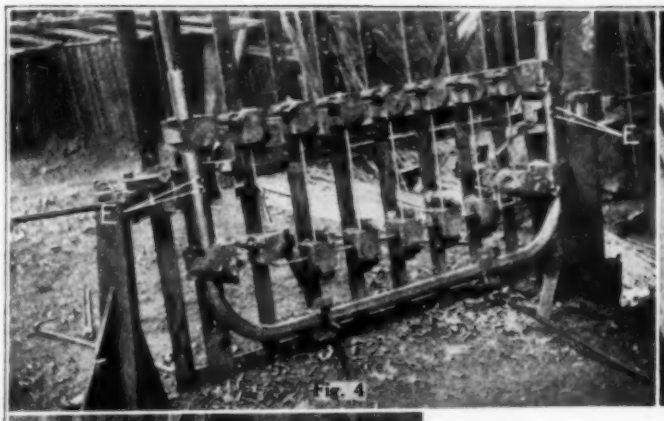
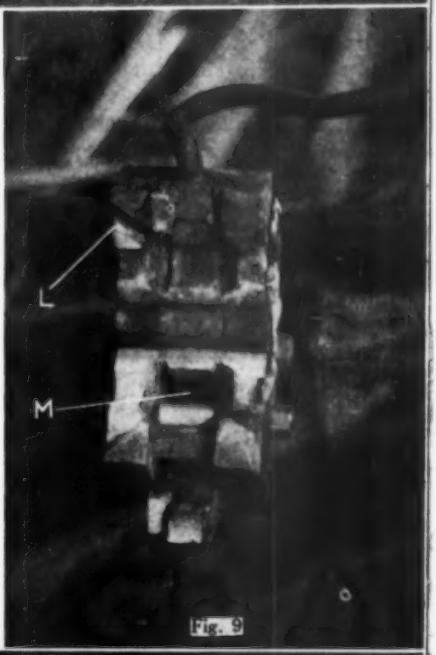
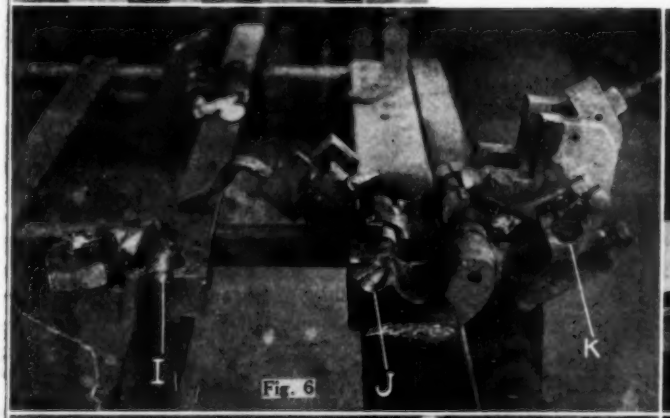
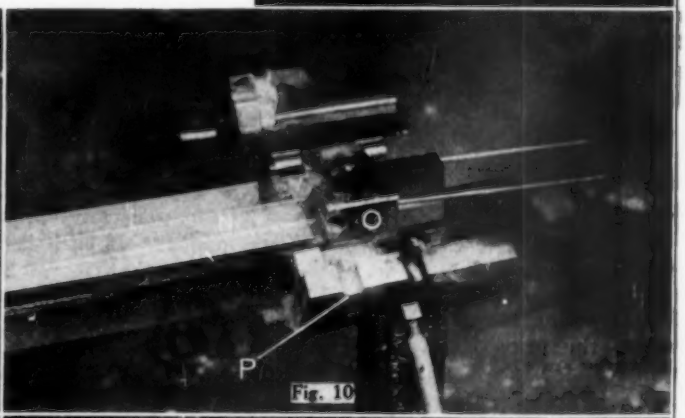


Fig. 4—Larger Chills Are Used for the Brackets. Fig. 5—Metal Enters the Two Holes in the Frame and Forms a Bracket on the Inside of the Pipe. Fig. 6—The Various Chills May Be Opened And Closed Easily. Fig. 7—One Type of Bracket Does Not Go Completely Around the Post. Fig. 8—The Rail Ends Are Made on Special Machines. Fig. 9—Chill for the Circling Bracket. Fig. 10—Rail End Chill Opened. Fig. 11—Fixture for Straight Post Style.







entirely around the bedpost is shown in Fig. 9. The runner is indicated at *L* and the removable core for the bracket dovetail at *M*. Of course, the chill runner is on top when casting is being poured. A finished bracket of the type which does not go all of the way around the bed post is shown in Fig. 7. This was made with a chill similar to the one shown in Fig. 5.

A group of fixtures used to hold the side rails while casting the male locking dovetail is shown in Fig. 8. A view of one of these chills is shown in Fig. 10. In this illustration the angle iron bed rail is shown at *N* and the removable chill for the male member at *O*. The runner is indicated at *P*. After the rail end is cast, the chill is opened and the removable chill *O* is knocked off with a hammer.

The chill fixture for another style of bed end is shown in Fig. 11. It may be noted in this case and on other types of clamps that the method of clamping the chills is simple. The clamps consist merely of bolts with bent over ends. These may be set up with one blow of the hammer when they do not fit. They also may be replaced easily.

Regular bending forms are provided to shape the tubing and the rods so that they will fit into the chills without trouble. No luting is needed around the chill to prevent overflowing of the metal as the metal chills quickly. The parts of the chill fit closely so that any fins are knocked off easily, and any slight roughness is covered with heavy paint or enamel.

Readers Comment

Note—Material appearing under this head does not necessarily reflect the opinion of The Foundry or of its editors.

Demands Quotation on Estimated Weight

To the Editors:

We operate a production automotive foundry. Recently we have been confronted with a new problem in estimating and quoting on castings. While this problem also may be new to you, we should be pleased to have your opinion.

A blueprint of a casting to be run in production was furnished us with the estimated weight of the casting attached. We were requested to quote a price based on the estimated weight furnished by the customer, with the stipulation that if the actual weight of the casting exceeds the estimated weight, the price to be paid by the customer for the additional weight will be figured for metal only and will not be influenced by the flat pound price quoted for the estimated weight.

From past experience with jobs of a similar nature and from comparisons with other work of a similar nature, we feel that there will be a variation of from 50 to 75 pounds in excess of the estimated weight furnished with the blue print. From this you may see that a wide variation in price is altogether possible.

In the past it has been our practice to quote a flat pound price until a casting has been made and the actual weight established. When the actual weight is known, a piece price is placed on each casting. This method enables us to remain close to our costs and at the same time to give an intelligent pound price quotation.

The customer previously mentioned contends that if it is possible to make a casting of a certain size for a given price, any increase in weight on the same job should increase the price only to the extent of the cost of the metal.

If we are to start a practice of this nature, where and what will it lead to?

Our customer states that foundrymen generally are quoting in this manner. If such is the case, it seems to me that it would be possible for the manufacturer to estimate the weight of the casting low enough to bring the price of the casting to practically any level he may desire.

Perhaps a reader of THE FOUNDRY may have encountered a problem of a similar nature and would care to present his ideas on the question.

Figures Are Wrong

To the Editors:

On page 246 in the March 15 issue of THE FOUNDRY a seeker after information claims that his foundry loss over a period of 10 years has not exceeded 3 per cent. A comprehensive reply follows the question under the heading *Foundry Loss Includes Gates and Scrap*, but I should like to ask him one question and that is: Is he sure he gets the correct figures from the charging floor and the shipping scales? I have been in the foundry for many years as a practical molder and foreman and I never yet have seen any person honestly showing a 3 per cent loss. Foundry loss includes metal lost in melting, metal lost in slag and metal in defective castings. If these three are added and taken away from the amount of iron charged in the cupola the loss will amount to more than 3 per cent. Statements like this, 3 per cent loss in the iron foundry and a production of 75 to 85 per cent in the steel foundry frequently place a foreman in an embarrassing position, if they do not actually injure him. A manager or some person in authority reads them and without an intimate knowledge of all the factors, upbraids his own foreman for not being able to duplicate them. I have worked in foundries as molder, inspector and foreman and I never have seen records of that kind.

An old saying in the foundry is that anything is possible on paper. I believe that the foundryman who made the statement on losses is sincere, but he failed to take all the factors into consideration. He is not alone in this respect. I am writing this in the interest of foundry foremen who know better, but who are restrained through policy from expressing their opinion. Of course all practical foundrymen are familiar with the situation, but unfortunately those who sit in the high places are not always practical foundrymen.

A FOREMAN.

Publish Instructions for Apprentices

Deutscher Ausschuss fur Technisches Schulwesen (German Committee for Technical Training and Education) which had an exhibit at the Detroit convention of the American Foundrymen's association on German methods of apprentice training now has translated its charts and instructions into English. Further information on descriptions and prices of the various fields covered may be obtained by addressing the organization at Potsdamer Str., 119b, Berlin W. 35, Germany.

George W. Gimlich has been appointed manager of the Dallas, Texas, branch of the Harnischfeger Sales Corp., Milwaukee, Wis. Daniel J Murphy, formerly manager at Dallas will open a new office at Baltimore.

Checked Molding Methods REDUCE Steel Casting Losses-II

By J. M. Sampson

THE casting illustrated in Fig. 4 is one of the most troublesome ever had in the Schenectady foundry. These castings have been made for nearly 10 years, shrink holes and blow holes turning up in a large part of every order.

When the job was finally singled out and attacked with a view to overcoming the shrinks and blows, it was found that the original method of making the job was as follows:

Green sand drag—dry cope—joint on *JJ*. Riser over top of casting at *A*—large gate at *E*. Horseshoe nails in boss *B* and lugs or pads *C*, *D*, *K*, and *P*.

These nails were put in both cope and drag, whistlers being taken up through the cope from the top of the pads *C*, *D*, *K*, *P*.

The castings looked all right when they left the foundry, but in the machine shop shrinks and blows were exposed in milling and drilling the pads *C*, *D*, *K*, *P*, and spongy metal was found when the boss *E* was milled. Obviously, it was wrong to have the gate into the boss *E*. The method was then changed to be as follows:

Green drag—dry cope—Gate at *J* in drag only—Risers at *A*-*C* and *K*; chill nails under the risers at *K* and *C* and in boss *B*.

These castings showed a shrink in the pads *K* and *C* due to the fact that the metal in the small riser necks at these points froze, preventing the risers from filling up.

Connect Risers

The method finally employed, and the one which produced sound castings, was the same as the preceding one except that a gate or trough was cut in the top side of the cope, connecting the two small risers over *K* and *C* with the large riser over *A*. The metal flowing up freely in the large riser ran through these gates or troughs in the cope and dropped into the small risers over *C* and *K*, thus furnishing relatively hot metal to feed the latter sections.

Fig. 5 presents an example of a case in which the failure of the foundry man to have the pattern made to be most adaptable to the molding method contemplated resulted in faulty castings being shipped.

It will be noticed that the boss *A* in front of the gate has sharply tapered sides. The finish allowance put on the pattern was made to carry the same taper as the sides of the boss. In order to feed the casting at this point by means of the gate it was necessary for the gate to be cut out to almost the same diameter as that of the boss, resulting in an inadequate mark being left as a guide for burning and grinding. A large number of castings were shipped out with too much stock ground off the face of the boss.

This could have been remedied and will be remedied in the future by having the finish on the face of the boss brought straight out, paralleling the axis of the boss. This will leave more room for the gate and, consequently, more room for the leaving of a plain mark to serve as a guide for the burners and grinders.

Experience had with the casting illustrated in Fig. 6 goes to show that blows are apt to be a more treacherous possibility than are shrinks, as regards small castings.

Many castings were made under the following method, and all were found solid in the machine shop:

Green sand; 4-inch riser at *A*, 9 inches high—joint on *JJ*; 3 x 5-inch riser at *B*, 9 inches higher; 1 horseshoe nail at *D*—gate at *C*.

A report was received from the machine shop saying that blow holes were being found in the small boss *D*, 14 castings being found to have these blow holes.

Gases Pocketed

There being no way for air, steam, or gas to escape from the pocket at *D* other than through a whistler; gas, air or steam had been pocketed and failed to escape through the whistler before the metal set. This was probably due to the molds having been damp, or the metal a little colder than usual. The chances are that a similar set of circumstances would not be encountered again for some time, and that no frequent trouble could be expected from blows. However, there would always be a possibility of blows being caused again for the same reasons. The safest way was to put a small riser, about 2½ inches in diameter, on the boss *D* and this was done, no trouble being experienced thereafter.

Excessive grinding is a source of considerable trouble in castings shipped out of the foundry. To illustrate such a case, the casting shown in Fig. 7 has been selected. It was necessary in order to make a sound casting, to put risers on the bosses *B* and *C* and on the trunnion *D*. The trunnion *D* being of small diameter, it was difficult to get a riser of any size on it and yet leave a mark or guide for burning and grinding. Out of shipment of 150 castings, 36 were reported as having been ground too low on the trunnion *D*. No change could be made in the molding method but a note of the trouble encountered was filed with the pattern card. Each time the pattern has come in, the burners, grinders, chipping room foreman and the inspector have been warned about the danger of grinding the trunnion too low, with the result that no more castings have been reported as having the same trouble as that met with at first.

Fig. 8 shows a casting which is an example of the unwillingness of the machine shop to remove a little stock from a section of the casting

Explains Methods

In this second, concluding, section of the article by Mr. Sampson, he explains further the difficulties that were experienced in obtaining sound steel castings, and the methods that were employed to eliminate defective castings. Consideration of the various castings and the elimination of shrinks and blows may be of use to other foundrymen in preventing similar troubles in castings of the same general type.

where finish is not called for can result in added delay and expense for both foundry and machine shop. The job was molded as follows:

Gate at *D*; 7 x 4 x 9-inch high riser at *C*—joint on *JJ*; 5 x 9-inch high riser at *B*; 4 x 9-inch high riser at *A*.

The first trouble appeared in the foundry. This was a shrink hole exposed by cutting of the riser and grinding at *B*. To remedy this five chill nails were placed under the riser to accelerate the cooling of the boss *B*. This measure proved effective, and the castings were shipped out.

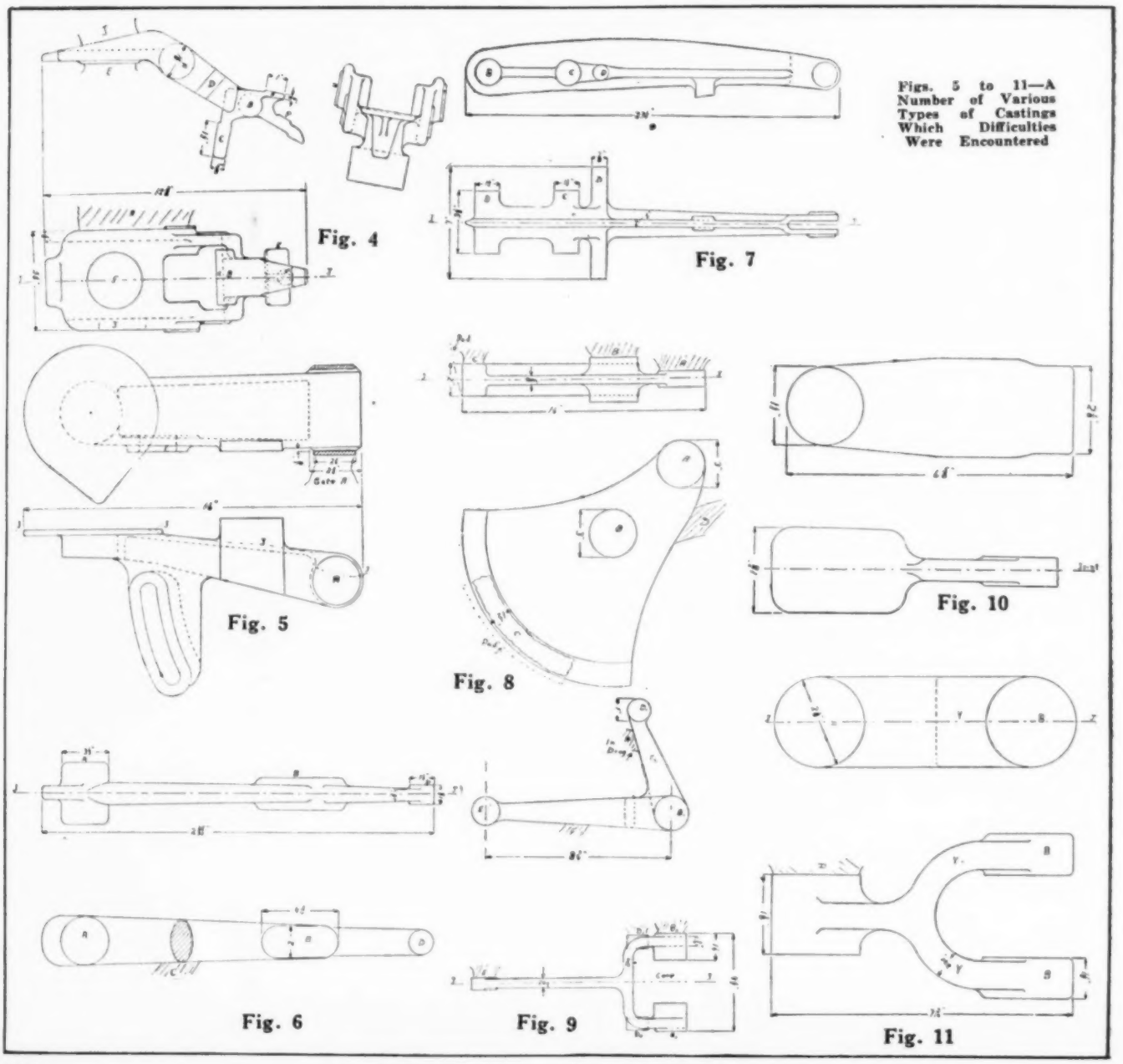
The next trouble appeared in the cutting of the gear teeth in the outer section of the casting coming under the riser at *C*. If it had been permissible to pad the riser *C* out over the webb instead of restricting the riser neck to the width of the gear teeth blank it is probable that no trouble would have been encountered.

Thirty per cent of the castings shipped were found defective in this way and had to be welded. Three per cent were rejected. When these rejected castings were made over the blank for the gear teeth was padded below the riser as indicated on the sketch in Fig. 8. These castings also showed small shrink holes when the teeth were cut but were welded and used. A note of this fact has been filed and on the next order an additional step will be taken to prevent this shrinkage. Nails will be placed in the gear teeth blank. It is admitted that this is not good practice, but as it is not permissible to pad the riser *C* in over the webb, no other method has yet been devised to cure the trouble in connection with the teeth.

Casting shown in Fig. 9 is another example of the danger of trouble from blow holes, even though the shrinkage problem has been amply taken care of. At first this casting was molded as follows:

Joint on *JJ*; green sand; gate at *F* (on joint); 3-inch riser at *B*, and *D*; 3-inch riser at *E*; 3 small chill nails in *B*-2 (bottom of mold and under core); 3 small chill nails in *D*-2 (under core).

For a while the castings made this way were sound, but at last a report came through of large blow holes found while milling the bosses D_2 and B_2 which had been located in the bottom of the mold, and chilled. The blow holes were so bad that the casting was taken into the foundry machine shop and the arm *G* to which the defective boss was attached was sawed into three pieces. It was found



Figs. 5 to 11—A Number of Various Types of Castings Which Difficulties Were Encountered

Fig. 4

Fig. 5

Fig. 6

Fig. 7

Fig. 8

Fig. 9

Fig. 10

Fig. 11

that the blow hole extended through the entire length of the arm—from boss D_2 to boss B_2. The arm was a mere shell, with walls about 1/16 to ⅛-inch thick.

Apparently, the mold was damper than usual and the unusual amount of steam generated was trapped in the lower part of the mold, having no chance to work its way out through the sand before the metal set.

To remove the possibility of a recurrence of this trouble the molding was changed so as to be as follows:

Gate at A (in drag); 3-inch risers at *D*, *B*, and *E*; ⅛-inch whistler carried through core from boss D_2 to D_1; riser carried through core from boss B_1 to B_2; 3 small chill nails in boss D_2 (in bottom); 3 small chill nails in boss B_2 (in bottom).

It may be noticed that in using this method, no blind passages or traps are left in which gas or steam may be cornered, there being an exit for steam and gas at every extremity of the mold cavity.

No trouble of any kind has been experienced with these castings since the latter method has been in use.

Trouble From Shifting

Fig. 10 shows a casting which caused trouble from shift. It is a peculiar case, since the pattern equipment and flask equipment was first class in every way. There were four half patterns on a plate, the one plate making both cope and drag.

Two molds were made as a check on the mounting of the patterns on the plate. The castings showed no perceptible shift. An order of some four hundred castings then was made and shipped. Later, a complaint was received from the machine shop to the effect that about half of the castings received were shifted so as to interfere with their insertion in the drilling fixture.

We were at a loss to explain the cause of the shift, but upon investigation it was found that the molder closing the molds had used a short pin instead of a long one. The short pin passing through only the two adjacent pin holes of the cope and drag flask, at the joint, permitted an appreciable wobble or skewing of the pin, resulting in a shift. The sample which had shown the pattern to be mounted properly was made, using long pins to close with. With the long pins passing through four pin holes— in the top and bottom flanges of both the cope and drag flasks— no wobbling or skewing of the pins was possible and any shift due to the clearance of the pin in the hole would be so small as to be imperceptible.

Fig. 11 shows a casting, many of which were rejected before a method was found which produced consistently sound castings.

To begin with, the design of the casting was such as to make it difficult for the foundry to get the bosses *BB* sound. It can be seen that these bosses were unnecessarily heavy as compared to the arms *YY* or vice-versa. The original molding method was as follows:

Joint on line *JJ*; large gate at *A*, fed by 4-inch sprue 9 inches high; ½-inch chill rod passing through center of bosses *BB*; ⅛-inch whistler up through cope from bosses *BB*.

This method produced blowy castings. It was thought that the light arms *YY* set before the gas, steam, or air pocketed in the bosses *BB* could be forced out through the whistler. Permission was obtained from the engineering department to increase the thickness of the arms from 7/16 of an inch to 9/16 of an inch, not enough, but it helped.

Table IX

Discounts in Foundry

Second Quarter, 1926

	Cause	Per cent by weight of cast
1.	Dirty	0.508
2.	Cracks	0.495
3.	Slag	0.491
4.	Shift	0.402
5.	Blow holes	0.304
6.	Shrinkage holes	0.291
7.	Cold metal	0.256
8.	Scabs	0.169
9.	Diaphragm blades burned	0.123
10.	Core set wrong	0.070
11.	Crushed	0.065
12.	Grinding	0.048
13.	Burning	0.045
14.	Pattern wrong	0.041
15.	Shake out (tears, etc.)	0.036
16.	Core wrong	0.030
17.	Broken in handling	0.013
18.	Strained	0.005
19.	Core omitted	0.002
10.	Misplaced riser	0.002
21.	Run out	0.001
22.	Flask closed wrong	0.001
23.	Cope raised	0.001
24.	Loose pieces omitted	0.001
	Total	3.400

The same method was used in making the molds after the pattern had been changed to conform to the new design as was used in the first case, except that a ¼-inch whistler was used instead of a ⅛-inch whistler. The castings made this way were explored and large blow holes still were found in the bosses *BB*. The arms *YY* were still freezing and preventing the entrapped air and steam from being forced up through the whistler.

It was thought that additional pressure in the mold would force the entrapped air and steam out through the whistlers more rapidly, and thus possibly fill the bosses *BB* with metal before the arms *YY* set. Accordingly, six inches more height was put on the sprue, making it 15 inches high. This produced the desired result. Four castings made in this way were explored and found to be sound. Out of the next shipment of 200 castings, none were rejected, and it was necessary to weld only six.

Defects Discovered in Foundry

Reference to the tabulation of losses during 1923, 1924, 1925, and first six months of 1926, shows that about 50 per cent of the condemned castings are discounted in the foundry and 50 per cent rejected in the machine shops. These discounts in the foundry for a three-month period this year have been tabulated in Table IX.

The Schenectady works steel foundry is probably neither better nor worse than most foundries producing similar work under similar conditions. The castings range from several to the pound, up to 10 tons. The metal is produced in two basic lined electric furnaces. Ladles are all bottom-poured.

While we have always appreciated the fact that bottom-pouring is not the best method for small molds and small castings, we have been reluctant about changing one of our furnaces over to an acid hearth and using the metal from it in making small castings, pouring from either small bull ladles or shanks.

However, this past few months has witnessed the installation of sorting and tabulating machines in our foundry office, whereby we are able to obtain quite readily and quickly individual costs of castings from every pattern. We also are able to sort and tabulate a great deal of information for statistical purposes, which would have been impractical before. Some of the tabulations made have shown us that we no doubt can afford to have two melting and pouring practices within the same shop. As things now stand, one of these furnaces will soon be lined up with an acid hearth and all small castings will be poured from small bull ladles or shanks.

By analyzing Table IX we find certain appreciable causes which are directly or indirectly due to the sand being improperly dried in the ovens, sand too wet, or poorly vented. We have designed and have in operation a large car type mold drying oven which uses preheated, circulating air, with this air kept high in humidity at the start, but gradually decreasing as the temperature increases.

This gives our dry sand work an

excellent mold surface, and we obtain a superior casting from molds dried in this particular oven. As soon as possible our other two mold ovens, now of the usual oil-fired type, will be changed over to this new design.

Facings for both green and dry sand molds are prepared in muller-type mixers, and are of proper moisture content as they leave the mill. However, it often happens that a box of sand is left over night or over the week-end improperly protected from air-drying. The molder sometimes proceeds to temper it to suit his taste and often gets it too wet. Proper supervision is the only remedy we know of in this case.

Considering the type of castings produced, we believe our losses due to cracks are fairly within reason. We try to bracket angles and changes in section judiciously, realizing that it costs money to remove these brackets afterward. Of the losses due to cracks, we believe a rather minor percentage is due to the quality of the metal.

We note 0.4 per cent of the weight cast was discounted due to shifts. This is due partly to a certain percentage of flasks that should be kept in better repair; and also due to the closing gang being careless, using a short pin where a long one should be used; sometimes due to removing the pins before clamping the job; sometimes, but infrequently, due to worn dowels in the split, loose pattern jobs.

Shrinkage Holes

Approximately 0.3 per cent was discounted due to shrinkage holes, either becoming apparent adjacent to intersections, or beneath a riser after it is removed and the pad ground down.

As a general thing, the larger steel castings show a very small percentage of losses, either in the foundry or machine shops, due to shrinkage holes. In the case of smaller and medium sized castings, however, it is a continual battle to keep these losses down. Some of the cases have been shown elsewhere in this paper. We know of no gilt edge rule to follow to overcome these losses, we simply have to treat each casting as a separate problem.

We could probably show lower losses due to cold metal, but the great difficulty we have is pouring off so many heavy and light castings in the same heat. While we endeavor to avoid doing so, it's not a clean cut division by any means.

Item 9 in Table IX, pertains to nozzle diaphragm partitions for steam turbine work, and is not of general interest to foundrymen, as this class of castings would only be made by few foundries.

Setting cores wrong usually is avoided by the use of tell-tales on core-prints. However, a job gets into the shop now and then without these proper precautions having been taken, and a number of bad castings will be made. Under this same heading comes certain cases wherein the man setting the cores must have been thinking of anything but the work at hand.

Under crushing we can find a number of reasons: Poorly secured cope, i. e. insufficient bars, gagers, etc.; cope not sufficiently rigid to withstand handling; bottom board or plate too weak and not resting on a proper bed; cores not setting in mold properly; in the case of dry sand, failure to shave the joint properly, or otherwise protect the joints from touching too hard when closing up the mold.

Grinding and Burning

Under grinding and burning we have certain aggravating losses. With each man in the cleaning room working piece work, the men burning off gates and riser find their fellow workmen who are chipping and grinding use rather pointed language if the cutting is not done close to the mark. This often results in the riser or gate being burned too close, with consequent loss of the casting. Here again is wide awake supervision required.

It may be interesting to note the small percentage of loss due to pattern being wrong. This is a direct result of careful checking of patterns before they pass into production.

The various remaining causes of discounted work in the foundry are shown in Table IX, and are practically self-explanatory.

The main object of this paper, however, is to show, possibly, the necessity for more and better knowledge of the losses after shipment, particularly those losses which the machine shops have to carry in their expense distribution. With a selling price equal to his competitors, that foundryman best aware of the above losses, what they are in order of their importance, and how to overcome them, will get the business.

To Open New Course

Beginning Sept. 30, the department of mechanical engineering of the Uniservity of Pennsylvania, Philadelphia, will inaugurate a new one-year course in fuel engineering. This course will be practical and comprehensive and will be directed by Prof. R. H. Fernald. He will be assisted by the regular instructional staff of the department and a group of nationally recognized authorities in the several subjects included in the course. Further information may be obtained by addressing Dean John Frazer at the university.

Tells Merits of Cast Aluminum Pistons

Developments in the art of casting and heat treating aluminum alloys within the last six years and in the design of aluminum pistons within the last two years have resulted in the production of pistons that are close grained, free from porosity and blowholes, that have twice the hardness of former aluminum pistons, and that will run with close clearance, asserted G. D. Welty, research engineer of the Aluminum Co. of America, at a recent meeting of the Buffalo section of the Society of Automotive Engineers.

Improvement in the art of casting the alloy of approxmiately 90 per cent aluminum and 10 per cent copper by forming the pistons in permanent molds instead of in sand molds has resulted in the production of between 25,000,000 and 30,000,000 such pistons since 1920, he said, and improvements in the heat treating process have played an important part in their success.

To meet the demand for closer clearances, the insert type of piston has been developed. This has a split skirt with steel inserts that act as spacers between the bearing faces and prevent excessive expansion. If the inserts are of cold rolled steel the piston can be fitted to about the same clearance as the cast iron piston of the same diameter, but if made of invar steel, which contains about 35 per cent of nickel and does not expand at all at engine temperatures, the piston can be fitted with a clearance of only slightly more than half a thousandth of an inch per inch of diameter. Such invar-insert pistons have a long life, said Mr. Welty, because they never come into contact with the cylinder wall due to their own expansion.

W. M. Bastable, formerly sales manager, Wilson Welder & Metals Co. Inc., Hoboken, N. J., and then New York sales manager of Electric Welder Controller Co., now is associated with E. D. Giberson & Co., New York, as manager of its wire department.

Bill Secures Historical Dope on Chaplets

By Pat Dwyer

BILL seemed to be wrapped in an atmosphere of gloom the other night. Usually he is as voluble as a magpie and keeps up a running monolog from the time he pokes his long nose in through the door until he raps the last pinch of ashes out of his pipe and then borrows a pipeful of my tobacco to smoke on the way home.

This time he smoked mostly in silence. He crossed one leg over the other, gazed pensively at the toe of the elevated shoe, sighed deeply and then repeated the process with the other leg. I waited patiently for some time, but finally hinted delicately that my curiosity was aroused.

"Far be it from me," I said, "To poke my nose into any person's private affairs, but you sit there giving such a perfect imitation of the whangdoodle mourning over the loss of its first born or one of Horatio Alger's heroes after the squire has foreclosed the mortgage on the old family grindstone, that I deem it my duty as one good man and true to kind of rally around and flock to the support of the party. Confide in me, my lad. My ears are open."

"Sure", said Bill, "They always are hanging open, but I don't see where that proves anything except that in that one particular you differ from our humble four-footed Hee-Haw friend who can fold his ears or stretch them open at will."

"Considering my well meant offer of sympathy," I said, "I think your comparison is in exceedingly poor taste. However, I am relieved to find that I was mistaken in my diagnosis. Judging by the sour edge of your tongue, your mind is not affected. All you need is a good dose of Epsom salts, a boiling hot bath, an all night sweat under a mountain of blankets and you will be as fit as a fiddle in the morning. You have the pip, the collywobbles, an acute attack of spring fever and need heroic treatment."

"Say," said Bill. "Listen, you're all wet. There's nothing the matter with me physically. I haven't got the pip or housemaid's knee, ingrowing toenails, fallen arches or the first fatal signs of dandruff on my coat collar. I am not the unlucky one in five and none of my best friends refuse to tell me that I should use blisterene. I don't see any black specks floating before my eyes and I can lace my shoes without calling in the neighbors. Lay off the funny stuff. I'm a better man than you are Rin-Tin-Tin!"

"All right," I said, "Have it your own way. You don't need to bark at me to prove that Aesop knew what he was talking about when he coined the fable about the dog in the manger. You won't tell me what is the matter with you and you won't listen to the few choice gems of wisdom and advice that I parade for your benefit. Perhaps I had better throw a bone under the table and let you creep in after it and growl."

"You would growl yourself," said Bill, "if you were in my shoes. The old man down at our place left the door of his office open the other day and a talking bug sneaked in and bit him. The poison spread all through his system. The result is that he is going to have a meeting every week of all the superintendents, foremen and assistant foremen. Each man in turn is to give a talk at these meetings on some subject connected with his department. The list is arranged alphabetically and I am the goat for next week."

"Well," I said, "I don't see anything in that to cause a falling of the barometer. You are neither deaf nor tongue tied. So far as I can remember I never have seen you during a discussion of any kind sitting in a corner with your finger in your mouth. So far as my observation goes no one else ever has a chance to say a word when you are around."

"Forget it," said Bill, "forget it. You are not looking at this thing from the right angle. I won't go so far as to say I am not willing to say a few words occasionally, when the conditions are favorable. I can talk to a man in the shop or I can talk to the old man in the office, but that is a give and take proposition. They talk back to me and I can keep going. I simply can't get up all alone before a crowd and talk away for half an hour without a peep out of one of them. I never saw a man yet that I could not look in the eye and say what I wanted to say, but the idea of facing a whole battery of eyes, critical eyes, gives me the everlasting creepy willies."

YE EDITOR KNOWS EVERYTHING

"You are making a mountain out of a molehill," I told him. "One pair of eyes or a hundred pairs of eyes are all the same. Your audience is not critical. Half of the crowd is not interested in what you are talking about and the other half is wishing you would cut it short so that they could fly away. All you have to do is pick out three or four stories, space them five or six minutes apart and fill in between with anything that comes into your mind.

"My own private opinion is that this habit of public speaking is developing into an epidemic. Half a dozen men can't even have a little luncheon together without a speaker. At one time public speaking was an art and like every art only within the gift of a comparatively few people. Today with all kinds and conditions of men pressed into service it is as standardized and just about as inspiring as the celery and olives. It merely is the course that follows the ice cream and the coffee. Men no longer spend any time in the preparation of a speech or confine themselves to a subject in which their knowledge exceeds that of men in the audience. They select any subject at random, look up a few printed references and they are all set. Occasionally they write to some likely place for information. The other day I had a letter from a man who wrote that he was scheduled to talk before the local luncheon club. The majority of the audience of course was not familiar with foundry terms, so he decided he would talk to them about chaplets. He would greatly appreciate my kindness if I would tell him how the name originated and how long it had been in use. Also any other information I had on the subject would be welcome. Here is a carbon copy of what I sent him:

If you had asked me to supply information on the origin of man, the discovery of the North Pole, migration of birds north and south with the changing seasons, the cause of the war in China, the present status of the Democratic party in Pennsylvania, what makes the wildcat wild, or any one of approximately 1001 topics of local interest, I could be of some assistance, either from my present knowledge or my proximity to a standard edition of the Encyclopedia Americana and a dictionary.

When you deliberately ignore an almost limitless list of interesting subjects, subjects with a background, a foreground and in many cases a middle ground, and propose to discuss an object whose paternity is doubtful, whose present status is precarious and which is utterly unknown outside an extremely limited circle, I am inclined to the opinion that you have permitted your bravery to run away with your discretion.

I am always responsive when the S.O.S signal is sent out. Nothing gives me greater pleasure than the opportunity of sharing what I may have of knowledge with others. Unfortunately, certain factors set a limitation to my generosity. When I don't know anything, I cannot share it.

I know what chaplets are. I have seen them made. I have made some in an amateur way. I have used them and occasionally have found them a useful alibi in placing the blame for a distorted or leaky casting. I always have accepted them *as is* and wasted no time in idle speculation either on their past or their future. Apparently I am not alone in this respect. So far as I know either oral or written tradition contains nothing that throws any light on your two questions: How did the word chaplet originate and how long has it been in use.

THE BOYS STEP OUT IN NEW EASTER BONNETS

Although I cannot supply a definite answer to either of your questions I am willing to draw on two sources of inspiration and give you the benefit of an effort along certain lines related more or less closely to the main theme. The first and most reliable source of inspiration and knowledge is an extremely handy volume which I keep on my desk and consult in moments of doubt. Also when I want to flatten out an opponent, figuratively, of course, although the book would serve admirably in a literal manner.

This able and scholarly work to which I refer, copiously illustrated and supplied with a profusion of footnotes is known as *Webster's New International Dictionary of the English Language.* It is 9 x 12 inches with a thickness of 5 inches and weighs about 15 pounds. Averaging the light and the heavy words it is readily apparent that Mr. Webster has collected practically every word that ever was used and packed them into this book of nearly 3000 pages including those at the back showing pictorial representation of birds, beasts, fishes, and more things than Alice saw in Wonderland. Let us put on our horn-rimmed spectacles and see what the eminent and erudite Mr. Webster has to say in regard to the word *chaplet.*

To save space, all explanatory terms in the dictionary are abbreviated. You probably are not cramped either for space or time. I am not and since this makes it unanimous, I shall quote the definitions in full and spell out all the abbreviations. On your marks! Get set! GO!

Chaplet, noun. (French, Chapelet, diminutive of Old French, Chapel hat. Garland, diminutive for Latin Cappa. See cap, also look up chapelet, chapeau, capellet).

1. A garland or wreath to be worn on the head.
2. A string of beads. a third of a rosary or 55, sometimes 59 beads.
3. In general a string of beads, a necklace.
4. Something resembling a string of beads, as a chaplet of the spores of Cystopus.
5. In architecture, a small molding carved into beads, pearls, olives, etc.; a carved astragal or baguet.
6. A kind of circular gridiron; an *Evelyn;* obsolete according to the Oxford English dictionary.
7. In foundry practice, any of the various metal devices for holding a core or a section of mold in place; especially a small, thin metal plate with a supporting stem for fixing in a block. The chaplet usually remains as part of the casting.
8. Variation of chapelet.

Not much there, you will say on which to base a talk or start a discussion. Out of eight references to the word only one deals with the foundry connection. If you are sufficiently broad minded to include garlands, necklaces, gridirons, beads, astragals (whatever they are) and baguets (ditto) in your discussion you may be able to get away with your proposed program. If you intend to hew to the line and talk about nothing but foundry chaplets I am afraid you are doomed to shipwreck. Another tragedy of the wide open conversational spaces. Lost with all hands.

Turning now to the second source of inspiration, imagination suggests first that chaplets have been in use since man first began making hollow castings, therefore they must have been known under many titles before some English-speaking molder invented the term chaplet. Second, an examination of foundry terms in contemporary European languages, shows they all are different and none of them resembles the English word. For example the chaplet and double head chaplet are known in France as *support de noyau;* in Germany as *kernstutze* and *wandstarkenkernstutze;* in Italy as *supporto dell'*

anima con una lamiera and *supporto con un gambo e due lamiere;* in Spain as *suporte de macho.* I have no Russian characters on my typewriter, but a phonetic translation of the Russian molder's names for a chaplet and a double head chaplet are *cherepok* and *dvoenoe cherepok.*

From the foregoing it is apparent that the word is not derived from any foreign language and therefore carries with it no entangling alliances. It is one of the few words in our language without any obscure roots extending back through devious and winding underground ways to the shores of the Mediterranean, to any of the varying camping places of the Aryan race, or to the walls of the Garden of Eden.

The first chaplets probably were tapered plugs and my own private guess is that some waggish molder in the sixteenth or seventeenth century saw a resemblance to the tall pointed hats, known as chapel hats, worn by the Dissenters in those days. Like many nicknames conceived sometimes in intolerance, sometimes in good natured fun and sometimes in ignorance, the term stuck. Owing to the migratory habits of molders, more pronounced then than now, the name went all over the country. Chapel hat of course was pronounced chapel 'at and by the easy transition which characterizes the spoken word as compared with written speech, the term easily became one word chaplet. Another possible explanation of the term, although one that presumably may seem far fetched, is that the word chaplet may be a diminutive of the word chap. In the British Isles the word long has been used familiarly and colloquially to designate a boy or young man. In recent years, of course the scope of the word has been enlarged to include any person of the male gender. In the third person he is referred to as a chap. In the second person the word is prefixed with the more or less familiar and endearing term old. Thus 'I say old chap, how about a loan of five bob?' or any other pleasantry of a like character.

In the early days of open sand molding, a possibility exists that a chap armed with a rod was employed or delegated to hold a core down to prevent it from floating. Eventually with the adoption of the two part mold a method was devised for placing a plug or rod in the mold itself for holding the core. Facetiously at first, this device was referred to as a little chap or a chaplet. In the course of time and as a result of constant use and association the word was adopted as a proper technical term and became incorporated in the language.

Through one cause or another the English language constantly if slowly has kept changing over a long period of years. An innumerable variety of words gradually passed out of the language to be replaced by others that bear little or no resemblance to the originals. You might just as well try to decipher an inscription on one of the pyramids of Egypt as to attempt a perusal of an early English manuscript with its abbreviations.

Recognition of this fact may furnish a possible clue to the derivation of the term chaplet. The word originally may have been *chalk plate.* That is the plate on which the chaplet stem rested. In modern practice chalk sometimes is used on a chaplet to prevent a deposit of moisture. Old time foundrymen may have employed the same material and the plate may have been known as a chalk plate. Through an easy and gradual transition favored by mankind's universal habit of slurring words and abbreviating them the term became successively chaw' plate, cha' plate, cha'plet and eventually chaplet.

That merely is my theory. I have no proof to back it up, but one guess is as good as another. I maintain a perfectly open mind on the subject and if any person can supply a more plausible definition that will show the true derivation I shall be glad to accept it.

THE BEST OF FRIENDS MUST PART

The term is familiar to all English speaking molders and is used almost universally, but in some shops alternative terms also are employed. Large, heavy chaplets whether used on the top or the bottom of a mold are referred to as *anchors* and double head chaplets are known as *studs.*

In modern foundry practice chaplets are used in an almost unlimited variety of sizes and shapes. Small steel stems not much larger than the lead in a pencil, 1-inch in length and with a ½-inch square tin head are used to hold radiator cores in place. Big, burly steel stems 1½ inches in diameter and with circular or square heads forged, riveted or welded in place are employed where heavy castings are made. Cast iron plugs, plain, threaded or spool shaped find application in some instances. Double head chaplets *T, H* or channel section, also perforated chaplets of many special shapes and sizes are used extensively in stove, heater, automotive and gas engine molds. Tin is used extensively for small chaplets and many large chaplets made of steel are tinned to insure a thorough amalgamation.

"Say," said Bill, "Lend me that thing. I'll take it down and read it and I bet the whole gang will swallow it like gospel. I don't know or care where, when or by whom the first chaplet was christened, but I know how and where to use them and these are the only features of any importance in a foundry. God bless you, my boy! You have saved me from a fate worse than death. Adieu. I will see you anon." He staggered forth into the night.

Ratio of Good Castings To Metal Melted

Question: What is considered a normal output of good castings for a foundry employing 27 molders on light ornamental castings, furnace castings and stove plate? We are not equipped with molding machines and only about 10 per cent of the patterns are mounted on aluminum match plates. The remainder of the patterns are loose. The iron all is carried and poured by hand and all miscellaneous material sand, coke, pig iron and scrap is transported by wheelbarrows. How many pounds of good castings should be made in a 9-hour day? How many pounds of iron should be returned to the cupola as gates, scrap and left-over iron?

Answer: Under the conditions you outline the daily output per man of good castings will be about 500 pounds or a total of 13,500 pounds for the entire crew. Gates, scrap and over-iron will amount to about 35 per cent of the total charge. To this must be added furnace loss and a certain amount of miscellaneous iron that never is recovered, amounting to an additional 5 per cent. Another way of presenting the same statement is to say that 13,500 pounds represents 60 per cent of the total amount charged into the cupola. Gates and scrap account for 35 per cent, 7875 pounds. Furnace loss 5 per cent, 1125 pounds. Total charge 22,500 pounds.

Safety Conference To Be Held

The third annual Eastern Safety conference will be held at Newark, N. J., on April 27. Stanley Coleman, assistant superintendent, Elizabeth Foundry Co., Elizabeth N. J., will speak on, "Safety in Foundry Operations." A. R. Bush, superintendent, Barber Asphalt Co., Maurer, N. J., will talk on, "Safety in Small Plants." A public safety film, "What Price Recklessness" will be shown and a banquet at 6:30 p. m. will complete the day's activities.

Study Electric Furnace Melting

Members of British Institute of Metals Discuss Induction Type Furnace at Annual Meeting in London

POSSIBLY the most important problem facing scientific and industrial metallurgists, particularly chemical engineers, is that of corrosion, according to a statement made by Alfred Mond, chairman, Imperial Chemical Industries, Ltd., at the annual dinner of the Institute of Metals in London on March 9. Mr. Mond, who was proposing the toast of the institute, also said that in a few years we should come to regard the navigation of the air as more important than that of the sea, and that the problems of aerial navigation immediately are connected with the problems of nonferrous metals, which are required to combine lightness with ability to stand heavy strains or high temperature.

The annual general meeting of the institute was held on March 9 and 10, when the report of the council was read, showing that the membership grew during the year 1926, from 1692 to 1801, thus representing a rate of increase that has been surpassed only once in the last five years.

For the second year in succession, John Dewrance, chairman, Dewrance & Co. Ltd. of London, was elected president, and Thomas Bolton, Thomas Bolton & Sons, Ltd., London, Henry Fowler, chief mechanical engineer, London Midland & Scottish Railway Co., and Dr. W. Rosenhain of the National Physical Laboratory were elected vice presidents.

In his presidential address, Mr. Dewrance summarized a number of experiments which he has been conducting during the past year on bronze founding, dealing mainly with crystallization of metal under various cooling conditions. The speaker said that the founder often finds trouble when he has to use copper containing more gas than that for which he has been accustomed to provide, and that it would help the founder if the members of the institute could get copper refiners to supply gas-free copper. Reference was made to the work conducted by the committee on corrosion research, and the president pointed out that the effect of corrosion is more widespread than is generally realized.

The afternoon session of March 9 was devoted entirely to a paper on electric furnaces in nonferrous metallurgy by Donald F. Campbell, consulting engineer, London. This paper dealt in a practical way with the principal electric furnaces now used for melting alloys of copper, nickel, zinc and silver, with special reference to induction furnaces of normal and high frequency. A table was given showing an actual day's run in a 75 kilovolt-ampere furnace used in Birmingham on 61:39 brass, and a comparison was drawn between the cost of running such a furnace and the cost of using pit fire. The author stated that under favorable conditions the power consumption when melting 60:40 brass in a 600-pound furnace should not exceed 220 units per ton, to which must be added the stand-by current.

Discuss Melting Losses

The discussion was opened by Dr. Brownsdon, Birmingham, who said when pouring cold metal into the furnace it usually takes 55 minutes to melt and then the metal should be superheated by about 100 degrees. Referring to the question of losses the speaker stated that in his opinion this question could be studied.

Under the best conditions his own losses were 1.1 per cent zinc in the form of oxide. With borax flux, under less favorable conditions, his losses generally were nearer 2 per cent. However, he added that financially it is not always the lowest loss that means most economical running. He thought that zinc oxide was formed mostly at the stage when cold scrap is added to the molten metal remaining in the furnace. Oxide also is formed along the sides of the lining, and the speaker was of the opinion that the formation of this oxide is connected with the material of the lining.

He announced his intention of attempting to melt brass in an induction furnace under sealed condition to see whether any oxidization of the zinc takes place. He regretted that the author had not dealt more extensively with the question of electric furnaces used for heat-treatment, as it is his opinion that the electric furnace has a great future in that direction. He said that American linings are better than those obtained elsewhere and that America and Germany are leading in research in the direction of the utilization of electric furnaces.

Wm. R. Barclay, Henry Wiggin & Co. Ltd., Birmingham, said he regretted that not more attention had been given to the arc furnace which he believed gives more elasticity to the choice of fluxes. He urged closer collaboration between engineer and metallurgist to improve mechanical details of furnaces. He also urged the extensive study of the question of costs and prophesied that the use of the electric furnace for heat-treatment gradually would increase. Alfred Glynne Lobley of Stockport mentioned that an electric arc furnace is manufactured in Great Britain.

Dr. Haas, who officially represented Deutsche Gesellschaft fur Metallkunde, said that where electricity is cheap every advantage should be taken of its use. He added that in Germany it is thought that modern metallurgy wants electricity to an increasing extent. H. H. Hayes, Birmingham, described his experience of an induction type furnace. He said that his average power consumption was 240 units per ton charged and 243 units per ton poured under the most favorable conditions, using only 10 per cent virgin metal. However, he stated, that several years ago he had been able to melt 42.82 tons per week using 218 units per ton. Referring to the question of linings he pointed out that furnaces can be rammed with every precaution but the lining breaks down because zinc gets into the cracks.

Mr. Frick, Sweden, first referred to the use of induction furnaces in steel. He gave a theory of the pinch effect and said that a new type of furnace which has been running for several months in Sweden up to now has given exceedingly satisfactory results. Dr. Rosenhain stated that in considering the question of cost one should take into account the question of heat losses. He added that the question of refractories certainly stands in the way of improvement and that it is extremely difficult to find a refractory lining which will stand the strain without giving way, because the temperature gradient between the cold coil and the interior of a furnace with a relatively small thickness of lining causes a considerable tension on the refractory. He said that in his laboratory he used a furnace made by the Ajax Electrothermic Corp., Trenton, N. J., which he has found extremely valuable in experimental work.

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How and Why in Brass Founding

By Charles Vickers

Wants High Lead Alloy

We would like to know of an alloy that will hold from 25 to 30 per cent of lead in admixture with copper.

We do not know of any *alloy* that will *hold in* lead but tin will do it, and that is the metal usually added. No difficulty should be experienced from lead sweat or dropping in the case of alloys containing only 26 per cent lead, but sometimes a little lead will ooze out in the case of castings containing 30 per cent of lead. Some makers of such alloys like to include about 1 per cent of nickel, thinking it holds the lead, although it is exceedingly difficult to find any good reason why this metal should be of value in such connection. In the case of the higher lead admixture such as the 50-50 lead-copper and the 38-lead; 2-tin; 60-copper mixes, it is necessary to scout around for something that will *hold in* the lead, otherwise it liquates and adorns the outside, preferably the bottom of the casting. As a flux in such cases the alkali and alkaline earth metal sulphates, are effective, also some sulphides, and sulphur itself. Other members of the sulphur family, selenium and tellurium are worthless in such connection singular to state. The same fluxes can be used with any leaded alloy to advantage, thus common plaster of paris is a good flux to use. A better general alloy for bearings than either the 26 or the 30 per cent leaded alloys is one containing from 20 to 22 per cent of lead and about 5 per cent each of tin and zinc, and the remainder copper. No difficulty is experienced in making such castings, flux or no flux.

Molding Brass Bars

We have trouble due to gas holes in making solid and cored red brass bars and we would like to learn how to eliminate the same. Also what is the best way to mold cored and solid bushings from 1 to 6 inches diameter; the horizontal or the vertical method? We mold such castings vertically and gate from the bottom, and on the larger sizes churn them through feeding heads. We melt in crucibles and charge 150 pounds heavy red scrap; 50 pounds of copper; 5 pounds of tin; 2½ pounds each of lead and zinc, then add 2 ounces of 15 per cent phosphor copper. We first melt the scrap brass, then add the copper, using about 2 inches of pine sawdust as a covering in place of charcoal. When the above metals are melted we pull the pot, then add the tin, lead, zinc and phosphorus in the order named, and pour at a medium temperature.

We would hesitate to say which is the best way to mold such castings as good castings can be produced either way. It is a matter of preference and training.

In the case of the horizontal mold the gases generated by the hot metal have better chance of escaping from under the bottom, and out of the top because the length of the casting is not enclosed in metal. Better success will attend vertical molding if the sides of the flask are perforated. Usually this is omitted and the gases have to escape into the mold cavity. Pouring from the bottom, of course uses the liquid metal as a piston to push out the gases, but if the sand is not open and on the dry side, the metal will not "lay" against the sides of the mold, and porosity may result. On the whole we believe the vertical method requires more careful molding than the horizontal method, and for sticks under 1½ inches diameter it is more costly.

We do not like the idea of *churning* bronze castings; it is all right for cast iron and semisteel, but it cannot be done with steel, and is rarely of value for brass, bronze or copper, as these metals should be cast with feeders that solidify after the casting. We also criticize the method of adding the white metals outside the furnace, because after such additions the alloy should be superheated for a little time to permit dissolved gases to rise from the melt. The sawdust is good as a covering, and it is better to use *deepeners* on crucibles in coke-fired furnaces. Put in the entire charge of brass and copper together and melt quickly, and when liquid add the phosphor copper, the white metals, more sawdust, then close the furnace and urge it so the metal will come HOT. Then pull, skim, cool to pouring temperature. This method should eliminate all holes from the castings.

Molds Bronze Tablet

We are contemplating the casting of a large bronze tablet in relief, and would appreciate any information you may give us concerning the molding practice, as well as the most suitable alloy for the purpose.

The following alloy will be satisfactory for bronze tablets:

BRONZE TABLETS

	Per cent
Copper	90
Tin	6
Zinc	3
Lead	1

Use a good stout flask for the mold, one that has the cope properly barred so there will be no *drop out* when the cope is being lowered down. It will necessary to make a facing of fine sand using part new and part old molding sand, screening through a fine sieve. The facing sand should be made at least 24 hours ahead of time it is to be used to give an opportunity to *mellow*.

Care has to be exercised in ramming the face of the mold to prevent the defect known as ramming away. This means the impression is found to be distorted after the pattern is drawn. Numerous articles have appeared in past issues of THE FOUNDRY on the subject of molding tablets. It is usually necessary to skin dry a large mold of this sort and the facing sand has to be mixed with this operation in view. A binder such as dextrin or flour should be mixed into the facing to hold the sand together after the water bond has been dried out. All that is required is careful molding practice.

Buy Alloy in Ingot Form

We have been trying to alloy magnesium with aluminum but as the former is produced in powder form we do not seem to get the proper alloy for cooking utensils. We want an alloy that will hold its luster after being polished, buffed and colored. The alloy we use loses luster after the utensil has been burnt in for cooking.

Powdered magnesium is not fit for alloying with aluminum. Magnesium in the ingot form, which is easily obtained, should be used. Any dealer in metals is likely to carry it.

Preaches the Doctrine of Adequate Prices

FOUNDRYMAN HUGH MARTIN
—keeps seven trucks busy

CONSIDER a foundry with a capacity of 140 to 160 tons a day that does a gross business of from a million and a half to two million dollars a year. Assume that this foundry is only 80 x 400 feet in size, including everything from the office to the cleaning room. Advance one step farther and learn that this foundry keeps seven of its own trucks busy picking up patterns and returning them with the finished castings. If the parties who listen to this story are foundrymen, polite doubt will be registered in every hearer's countenance.

Continue again and absorb the information that the office work is handled by four girls and two men, that a cost system in use is so complete as to give exact cost on every casting made over a period of several years. Then hear that the executive staff includes the president, who sells castings in addition to exercising an active supervision, the secretary who attends to the office and financial matters, a superintendent, coreroom, yard and night foremen and from 150 to 175 men about 50 of whom are molders. Add to this the information that no storage capacity is available for patterns, that work is delivered within 24 hours or in extreme instances in 48 hours and that every job accepted is made to show a profit. By this time foundrymen listeners are likely to apply the famous Roosevelt term, if not the short ugly word, to the tale that has been told them.

Monday night, March 28, Hugh Martin thus touched upon some of the high lights of his foundry and its operation at a meeting of the Cleveland group of the Ohio State Foundrymen's association. Mr. Martin who with Harry H. Wyatt heads the Detroit Gray Iron Foundry Co., Detroit, told these facts and many others in proving to a gathering of about 75 foundrymen that all is not wrong in the jobbing foundry business and that, properly conducted, a jobbing foundry is a good business venture.

The main points and practices upon which the Detroit Gray Iron Foundry Co. has built its success were given in THE FOUNDRY for Jan. 1, 1925, but as explained by Mr. Martin himself they are worthy of further comment, even at the risk of some repetition.

This firm started in business with a definite line of work in mind, namely cast iron dies and die accessories for automotive body and fender work. It built its reputation upon a quality product delivered as promised and with lightning speed. True, a certain amount of general light machine tool castings, breakdown repairs and a limited amount of bench work is accepted but this is used mainly as fill-in, or to accommodate customers. The bulk of the business is on the die castings previously mentioned.

When Mr. Martin, who had been employed by the American Car & Foundry Co. embarked upon his own enterprise about 1916, making die blocks was a task approached with much respect by automobile makers. Usually a block or chunk of gray iron was cast and then by a laborious machining process, the contour of the proposed sheet metal stamping was cut from this block, like sculpturing a statue in reverse. A set of rings in that day might take from 6 to 8 months to complete. Today even a punch and pad for a body die at the plant of one of the leading body builders requires only seven hours. This is due to the close limits, the approximate perfection to which it is possible to follow the contour of the model in a gray-iron casting for these dies.

The Detroit company supplemented its idea of a specialty, well made, by determining upon the policy of immediate service and prompt delivery. In the automobile business, where every minute lost means idle time on stupendous equipment, appalling overheads and perhaps a delay in reaching a market with a new model at the psychological moment, this item of speed spelled success. Old customers of the foundry have implicit confidence in this factor of immediate service.

Mr. Martin said, "The worst I could wish my dearest enemy, is that he might be pursued and harrowed by five automobile company *followup men.* These men never have a chance to descend upon us."

As soon as a pattern is delivered to the foundry by one of the Detroit Gray Iron Foundry trucks, or through the agency of the customer, it is tagged, assigned and goes to the coreroom for any necessary cores. Usually the pattern is in the sand inside of half an hour. If the job is small, it may be molded, cast and delivered within a few hours' time. By having its own system of collection and delivery, the foundry accepts all responsibility immediately after the customer places the pattern in the hands of a representative of the foundry. The time is stamped on the job ticket when the pattern reaches the foundry office and again when the pattern leaves the shop with the finished casting to go to the customer.

A third principle upon which this jobbing foundry has built its business is a broad policy of advertising. It expends from $800 to $1000 a month in advertising its service and its product. A liberal use in its advertisements of photographs and nontechnical descriptions of various steps in producing its castings fixes in the minds of the public the name

of the firm, coupled with a meritorious product.

In response to a question at the Cleveland meeting Mr. Martin said:

"No, advertising does not actually bring the business to the door. We never had anyone call on us with one of our advertisements in his hand and say, 'Here's your ad, I want to buy,' but even doctors and dentists who read the club, society, commercial or daily newspapers in which we advertise know the name, Detroit Gray Iron Foundry Co., and, believe me, if a plant manager finds dissatisfaction with the castings he is getting, he is sure to say to his purchaser, 'Better try some of those castings I saw advertised by the Detroit Gray Iron Foundry Co.' "

This carefully considered advertising has placed competition on the defensive, and even has resulted in some instances of competing foundries soliciting business on the basis of their product being "as good as the Detroit castings." Further, the education of the buyer, the repetition of the points in workmanship, deliveries and service have served to remove from the buyers' collective mind that ever-present thought of lower price.

The die castings required by the automotive industry run into high tonnages as shown by figures given by Mr. Martin. As much as 25 to 30 tons of dies may be required due to the change in design of a fender. With a firm making 13 different models, and with, of course, four fenders to each car, some idea may be gained of the castings business that accrues from changes in models. One builder of a high-grade car wanted a change made in its fenders on a model then going through its shops. The Detroit foundry made and delivered 14 tons of fender rings in 49 hours from the receipt of the order.

A unique method of molding is practiced in this shop. Usually the actual model for a fender or body shape is delivered to the shop. This model is suspended about 4 or 5 inches above an iron plate and a mixture of sand, linseed oil and dextrine binder is rammed under it, after which the mold is pressed down firmly upon the surface and withdrawn. The plate carrying the sand impression is placed in an oven and baked. If these cores are large they are backed up with brick, to give a comparatively thin section of sand at the face of the pattern or model.

On removal from the ovens, the face of the mold, or core as it may be called, is checked carefully by printing the pattern back and correcting any surface irregularities by filing. A facing then is applied, the core is placed with the pattern in a flask and the remainder of the mold made in the usual way. All work even to operating the cranes and pouring the iron is paid for on a piecework basis.

All ramming is done with air hammers, and the green sand portions of the mold made of No. 8 loam gravel are nailed liberally. When the molds are poured, the face formed by the core, previously described gives a semblance of a chill to which Mr. Martin ascribes the long wearing qualities of the dies.

A mixture of malleable iron and malleable scrap ranging from 1.25 to 1.75 silicon with manganese about 1.00 per cent, is melted smoking hot, poured with liberal gates and risers and fed somewhat in the manner of a steel casting. The metal is said to have no shrinkage when produced from this metal and poured in the manner described.

Mr. Martin, in closing his address remarked on the poor return secured by foundrymen from the character of the service they render to industry. In the construction of the modern automobile, gray iron castings form some of the most vital and intricate parts of a modern car and yet these are the cheapest product entering the machine. Other parts may be welded or doctored in some manner to make them serviceable, but if a flyspeck is found on a cylinder, back it goes to the foundry.

Further, foundrymen do not insist upon a profit. They sell upon the buyers' terms. Instead of creating respect or gaining business by this procedure, said the speaker, they lose both their profit and the goodwill of the purchaser. Large firms do not want to do business with a concern that is not sound and a price-cutting foundry certainly is not headed for business success. The Detroit foundry, said Mr. Martin, accepts no work unless it pays a profit and he cited figures on earnings during the past year to support his assertion that this policy pays.

To Hold Convention

Canada's first steel and power show will be held in the new Varsity arena, Toronto, on Aug. 31, Sept. 1 and 2. The event is sponsored by the 12 leading Canadian organizations in these fields of industry. Technical sessions will be held during the 3 days, in connection with the exposition which will have many operating exhibits.

To Celebrate Jubilee

The American Electrochemical society will celebrate its silver jubilee at the coming national spring meeting which will be held at the Hotel Benjamin Franklin, Philadelphia, from April 27 to 30. Brief accounts of the early days of the society will be presented by several of the charter members. C. G. Schluederberg, Westinghouse Electric & Mfg. Co., East Pittsburgh, Pa., is chairman of arrangements of the program commemorating the founding of the society and Prof. Edgar Fahs Smith, University of Pennsylvania, Philadelphia, will preside at this session.

An interesting program will be provided for the technical sessions. Gaseous reduction of iron ores will be discussed in communications from a number of noted American engineers, Prof. Konrad Hoffman, Breslau, Germany; and Prof. Heihachi Kamura, Tokyo, Japan. Gaseous reduction of tungsten and molybdenum oxides will be discussed in a paper presented by E. W. Engle, Fansteel Products Co., Chicago, and the reduction of tin ore by E. F. Kern, Charles Mantell and Colin G. Fink, Columbia university, New York. Electrochemistry of concentrated solutions will be discussed in a symposium by such authorities as Scatchard, Webb, Harned and LaMer. Prof. Peter Debye, Zurich, Switzerland, will attend this meeting also and present a paper on, "Dielectric Constant of Electrolyte Solutions." On Saturday morning a session on the electrodeposition of metals will be held.

Engineers To Meet

A spring regional meeting of the American Institute of Mining and Metallurgical Engineers will be held at the Hotel Cleveland, Cleveland, April 19 and 20. Papers in the technical program will be presented by C. K. Leith, professor of geology, University of Wisconsin, Madison, Wis.; J. V. W. Reynders, consulting engineer, New York; Arthur E. Kitson, director of geological survey of the Gold Coast, London, England: Major N. R. Junner, London; Carl Zapffe, Northern Pacific Railway Co., Brainerd, Minn.; Robert Hadfield, Hadfields Ltd., London; M. G. Corson, consulting engineer, New York; H. M. Boylston, professor of metallurgy, Case School of Applied Science, Cleveland; T. L. Joseph, E. P. Barnett and E. C. Wood, experiment station, United States bureau of mines, Minneapolis. Metallurgy and resources of manganese ores will be the subjects under discussion.

CHICAGO Prepares for A.F.A. Guests

Interior Main Entrance of the Edgewater Beach Hotel, Chicago, Scene of the convention of the American Foundrymen's Association, June 6 to 10

FURTHER steps in the arrangement of entertainment features for the convention of the American Foundrymen's association in Chicago during the week of June 6 were taken at a luncheon meeting of the general committee held Monday, March 28. This meeting of representative Chicago foundrymen was held at the Palmer house and was featured by the enthusiasm manifested by the chairmen and vice chairmen of the various local committees, all of whom were present at the meeting.

Since the Chicago industrial section offers exceptional opportunities to convention visitors for plant inspections, the general committee agreed that next to the technical and business sessions, the plant visitation program will be the leading feature of the convention week. The plant visitation committee, which is composed of members of the Chicago Foundrymen's club, started its preconvention activities some weeks ago and now has the program well under way. Under the tentative plans Monday, June 6, and Friday, June 10, will be held open for organized group plant visitation tours under escort. Members of the plant visitation committee will act as guides on the various trips. On Tuesday, Wednesday and Thursday, a list of plants open to visitors may be obtained at the plant visitation booth in the Edgewater Beach hotel.

The ladies entertainment committee is completing the arrangements for the entertainment of the ladies on Tuesday and Wednesday. This entertainment will include automobile trips through many of the beautiful sections of the city and the suburbs and programs at the theater and one of the large stores in the Loop district. In addition the ladies will participate in the general entertainment to be provided for Tuesday evening, the banquet on Wednesday evening and the boat ride on Lake Michigan on Thursday afternoon.

At the meeting the general committe assigned duties to the various sub-committees and decided also that the chairmen and vice chairmen should be required to report to the general committee on the complete personnel of the sub-committees by April 15. Several of the committees, including publicity, finance, hotel, reception and several others, have made considerable progress in their organization and work. B. B. Wilson, vice chairman of the hotel committee, reported a large number of reservations, but ample facilities remain as yet unreserved. Arrangements are being made to take care of possible overflows at nearby hostelries. George H. Rolinson, president of the Chicago Foundrymen's club, and also chairman of the plant visitation committee, reported that the plant visitation work is well under way. General Chairman William J. Nugent, president of the Nugent Steel Castings Co., presided.

While the official list of plants available for visitation still is incomplete, more than 30 concerns have expressed their willingness to throw open their doors during convention week to convention visitors interested in studying methods, practices and equipment. Plants which thus far have given assent to visitation are the following:

Chicago Hardware Foundry Co., North Chicago, Ill.; Western Foundry Co.; International Harvester Co., Deering Works; Nugent Steel Castings Co.; Hubbard Steel Foundry Co., East Chicago, Ind.; Whiting Corp., Harvey, Ill.; Burnside Steel Co.; American Brake Shoe & Foundry Co.; American Steel Foundries, Indiana Harbor, Ind.; Leitelt Bros.; Chicago Steel Foundry Co.; Griffin Wheel Co.; Cribben & Sexton Co.; James B. Clow & Sons; Pettibone Mulliken Co.; Kling Bros. Engineering Works; Western Electric Co., Hawthorne Works; Imperial Brass Mfg. Co.; Link-Belt Co.; Faunt Bros. Brass Foundry; Sloan Valve Co.; Belle City Malleable Iron Co., Racine, Wis.; W. A. Jones Foundry & Machine Co.; Ace Foundry Co.; Ferguson & Lange Foundry Co.; Illinois Malleable Iron Co.; Electric Household Utilities Corp., Waukegan; National Malleable & Steel Castings Co.; H. W. Caldwell & Son Co.; and Magnus Co. Inc., Chicago bearing metal plant.

Approval of the list, with any additions that are to be made later, will be given by the plant visitation committee and the general committee. The list then will be published in pamphlet form and will be made available to visitors at convention headquarters.

The apprentice committee of the A. F. A. has announced that the annual apprentice contest, as developed at the Detroit convention, has been expanded to include both pattern making and molding contests for the 1927 Chicago convention. The plan calls for the holding of district molding and patternmaking contests for reg-

ularly indentured apprentices under 24 years of age.

Best castings and patterns entered in the local contests will be sent to the convention at the Edgewater Beach hotel. From these the three best in each class will be selected by a committee of judges and will be designated as first, second and third prize winners. In connection with the contest, apprentice training will be discussed at a special session of the Chicago meeting, the leader of the session being H. A. Frommelt, International Correspondence school, Scranton, Pa., one of the leaders in the apprentice training school.

These district contests are being organized by foundry associations and plants interested in apprentice training. The apprentice committee of the A. F. A. is formulating a set of regulations governing these local competitions so that uniform conditions may prevail. The A. F. A. committee also furnishes sets of blueprints for the patterns to be used in the molding contest and drawings of the casting for which a pattern is to be made in the patternmaking contest. Copies of these regulations and blueprints may be obtained by writing to the secretary, American Foundrymen's association at 140 South Dearborn street, Chicago. The molding contests last year were won by apprentices of the General Electric Co., Erie, Pa., and the Falk and Bucyrus corporations, Milwaukee.

Appointed Sales Manager

Joseph G. Worker has been appointed general sales manager and elected to the board of directors of the American Engineering Co., Philadelphia. Mr. Worker was graduated from the University of Illinois, Urbana, Ill., and for 15 years was associated with the Westinghouse Electric & Mfg. Co., East Pittsburgh, Pa., where for the latter five years he was manager of the stoker section. For the past five he has been assistant to the president of the American Engineering Co., Philadelphia.

Firms Consolidate

Harris Alloys Inc., the National Alloyed Metals Co., and the Murray-Harris Wire Co., have been consolidated by purchase and business will be conducted under the name of the National-Harris Wire Co., Newark, N. J. All obligations of the three firms will be assumed by the National-Harris company.

Completes Forty-three Years of Service

The Coeur d'Alene Hardware & Foundry Company of Wallace, Idaho, recently added a new building to its salesrooms. The opening of this addition marked another milestone in the progress of this firm. Its growth has paralleled the development of mining in the famous ore-producing region in which is its home.

The largest mercantile establishment in the Coeur d'Alene, this concern is the outgrowth of a business that had its inception in 1884, when J. H. Marks and W. W. Hart forsook placer *diggins* for commercial pursuits. From its original frame buildings, having an aggregate floor space of 5000 square feet, the firm has expanded to the point where it now utilizes 140,000 square feet in thoroughly modern structures. In the meantime, its roll of employes has increased from 7 to 140.

The company designs and builds certain mining machinery, and acts as selling agent for several well-known lines. It also does a general supply business. Ellis L. Hale has been manager of the organization since 1918. Other officers are: Jerome J. Day, president; Harry L. Day, vice president; James F. McCarthy, treasurer; and L. C. Wilson, assistant manager.

Belgian Foundrymen Meet

Association Technique de Fonderie de Belgique held its congress in Brussels on April 9 and 10 at the hotel of the Belgian Society of Engineers and Industrialists. The congress was opened formally on Saturday, April 9, and the exchange paper of the American Foundrymen's association was presented at the first session. This paper dealt with the subject "The Thermatic Treatment of Iron" and was prepared by O. W. Potter, University of Minnesota, Minneapolis. The afternoon session was devoted to a paper on "Professional and Technical Training in Connection with the Foundry Industry" by Arthur Soupart, director of the Musee Professionnel de l'Etat et de l'Ecol Industrielle et Professionnelle de Morlanwelz-Mariemont. This was followed by the exchange paper of the French Technical assocition on "Making Heavy Castings" by Henri Fabre, director of the foundry of Societe Bracq Laurent a Achicourt.

On April 10 Paul Ropsy, president of the Belgian foundry association presented a paper on "A Contribution to the Study of Carbon in Cast Iron." This was followed by the exchange paper of the Institute of British Foundrymen on "The Manufacture and Utilization of Nickel-Chromium Iron and Cobalt-Chromium Iron Castings," which was prepared by Ferdinand Kayser, Sheffeld, England.

Appoints Sales Agent

Chicago Pneumatic Tool Co., 6 East Forty-fourth street, New York with offices in Dallas and Houston, is closing its Texas offices incident to the appointment of Whealton & Townsend, Inc. with main offices at 120 East Brady street, Tulsa, Oklahoma, as distributors in Texas east of meridian 102. Whealton & Townsend, Inc. will maintain sales and service offices in both Dallas and Houston, and will establish additional offices elsewhere.

Production Increases

Production of metallic magnesium in the United States increased from 128,000 pounds in 1924 to 245,000 pounds in 1925 according to a report from the department of commerce. The average price per pound for ingots dropped from $1.07 in 1924 to $0.86 in 1925. Considerable use of magnesium is being made for castings for aircraft parts, microscope parts, golf club heads, etc. Magnesium also is being used as a deoxidizer and desulphurizer for nickel and monel metal and as a scavenger for brass and bronze. Increasing demand for aluminum alloys containing magnesium in 1925 was due to a better understading of the properties of these alloys and to the supply of proper equipment for fabrication and heat treating.

New Monorail Catalog

Louden Machinery Co., Fairfield, Iowa, just has completed a new 56-page catalog describing its industrial monorail systems. The catalog is illustrated profusely with numerous blueprints and photographs from typical installations. Engineering details and other data are presented which will enable those interested in determining the type of equipment for their particular plants.

State Mfg. & Engineering Co., recently has removed to its new plant at 2756 Fulton street, Chicago. The firm manufactures a universal saw machine. Victor Fehrn is president and general manager and George Randquist is secretary.

Use Special Tools When Turning Patterns

By Walter C. Ewalt

FIXED tools, or those which are fastened to a tool post mounted on the movable carriage of a lathe, are used extensively in certain types of pattern turning. Generally the fixed tools resemble the corresponding type of hand tool and are classified under the same names.

When the occasion arises, a patternmaker will devise special tools which will enable him to turn the work more satisfactorily. A number of the tools commonly used in the pattern shop are shown in the accompanying illustrations.

The gouge or roughing tool is shown in Fig. 1. This tool is made by drawing out a piece of steel at one end to a thickness of $\frac{1}{8}$-inch. The drawn end then is bent into a circular form and an opening is left at the side as well as in the back for the disposal of the shavings, as may be noted in the illustration. The outside face is cone-shaped at an angle of approximately 10 degrees and is hollow ground. This feature prevents the bottom portion of the face of the tool from coming in contact with the work.

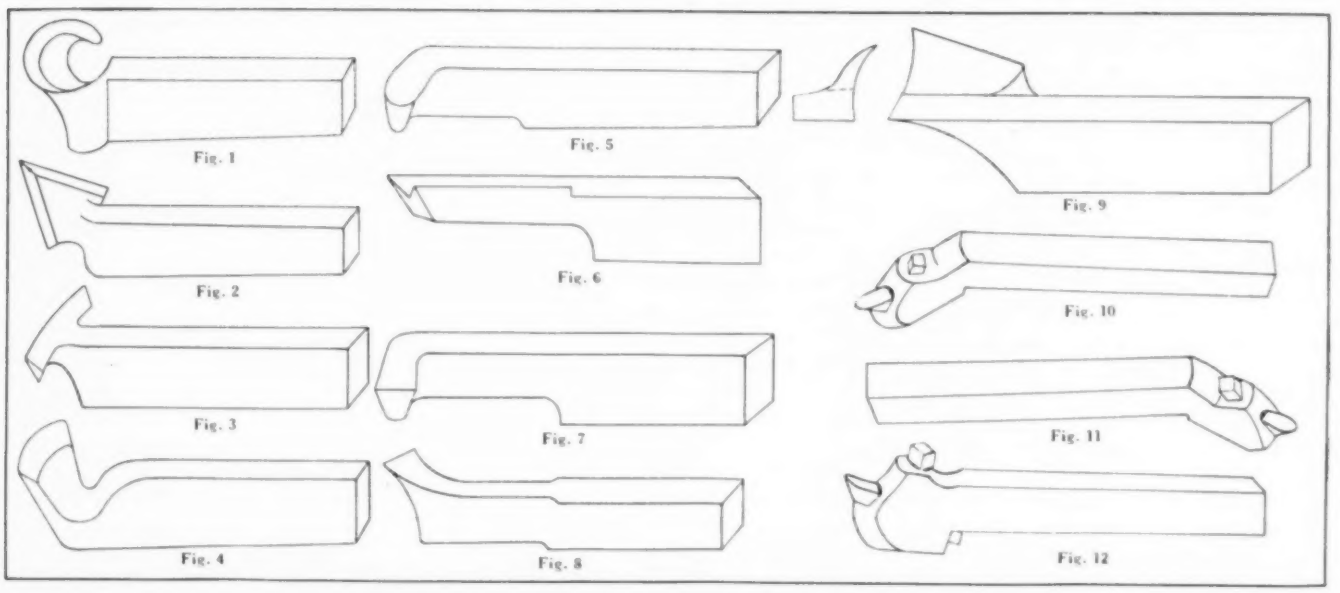
The inside taper of the cutting edge is constructed at an angle of approximately 30 degrees from the outside face. The inside taper never is ground after once being shaped as all of the grinding and sharpening is accomplished on the outer face. However, the slip stone is used on the inside face or taper edge to take off the wire edge. The circle on the gouge may be built to turn either right or left.

The gouge is classified as a cutting tool, since when traveling forward it cuts the fibers of the wood. No other tool, either hand or machine, is capable of cutting off as large an amount of wood when making a single cut on a cylinder. Although considered a roughing tool, a fairly smooth surface may be produced by feeding the tool lightly into the wood.

The fixed tool which corresponds to the hand double-edged skew chisel is shown in Fig. 2. Both edges usually are sharpened so that the tool may be used to cut either right or left. However, the tool must be adjusted in the rest for either direction. The cutting edge is placed on the work in exactly the same manner as the hand tool, which was described in March 15 issue of THE FOUNDRY. However, the operation is simplified since the tool is held firmly in the tool post with a set screw. If the tool is sharp and is placed properly, an exceptionally fine finish may be obtained. A perfectly straight line may be cut with the fixed tool, an operation which is difficult with the hand type.

The fixed tool shown in Fig. 3 is used between shoulders where it is difficult or impossible to use the skew tool. The center of the cutting edge projects forward slightly from the ends so that it may be adjusted either right or left up to the shoulder. The fixed tool shown in Fig. 4, which is similar to the one illustrated in Fig. 3, is made with the cutting edge ground to a radius and is used efficiently for straight work such as facing segments. An ordinary boring tool is shown in Fig. 5. A boring tool also is shown in Fig. 6. This tool has a special cutting edge, as may be noted, and when used properly makes a fine finish.

A boring tool for small holes is shown in Fig. 7. A tool of the same shape and having a cutting edge on the other side is used to turn the outside diameter and is exceptionally efficient. Fig. 8 shows a cutting off tool. This tool should be ground only on the under side and then rubbed lightly on the upper side to remove the wire edge. A tool of this type is useful in cutting down shoulders and in smoothing the wood between shoulders. Another outside diameter tool is shown in Fig. 9, which has cutting edges on the sides and at the end.



FIGS. 1 TO 12—GROUP OF FIXED TOOLS USED IN PATTERN TURNING WHICH MAY BE MADE IN THE FORGE SHOP

Many shops are equipped with tool holders similar to those shown in Figs. 10, 11 and 12. These holders are arranged so that small steel cutters may be inserted and held in place by the set screw. A holder of this type with a number of small steel cutters will replace a number of forged tools. Fig. 10 shows a right hand offset, Fig. 11 a left hand offset and Fig. 12 a straight shank.

When it is necessary to do considerable turning in making core boxes for spherical patterns, the radius tool, shown in Fig. 13 will be found convenient. This tool consists of a worm and worm gear connected to a stock which is fastened in a tool holder. The cutting tool is fastened to the worm gear and is operated by turning the hand wheel which is keyed to the worm. A sphere may be turned on this device much faster than by hand since hand turning requires the use of a template and it is necessary to stop the lathe often to use the template.

A number of special tools will be found useful in certain types of work. Although the handle shown in Fig 14, is not a pattern, it illustrates the type of work the patternshop must make. The method used by the author in making this handle may be interesting. If only one or two pieces had been wanted it would have been cheaper to screw the wood on a face plate, turn a quarter round to the center and then reverse the handle and turn the opposite side. However, the patterns were made of hard maple and several hundred were wanted.

A blacksmith and machinist made the tool shown in Fig. 15 and the machinist fitted the tool into a face plate as shown in Fig. 16 and the square part of the tool was sunk into the face place 1/8-inch to prevent turning. After the wood was cut to shape on the band saw, a 2-inch hole was bored through the center of the hand hole and holes drilled for stove bolts. The outside round then was machined off, in an operation which will be described later in an article on the circle saw. Then a jig, Fig. 17 was made to set on the carriage of the lathe the handle was fastened in the jig by stove

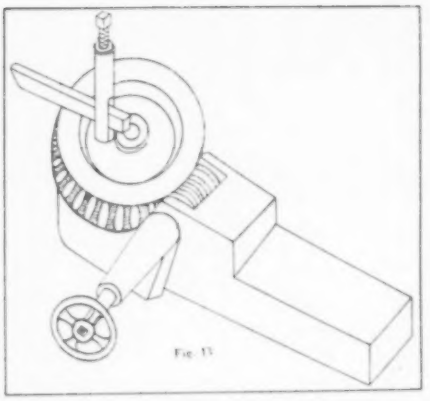


FIG. 13—RIG FOR TURNING SPHERICAL PATTERNS

bolts and shorter stove bolts later were placed in the holes to prevent splitting. Fortunately the lathe had a hand feed rack which allowed the work to be moved gradually into the tool.

The tool then cut out the extra half inch on a side and at the same time rounded the inside surface. After one side was finished the handle was reversed and the other side cut out the same way. Here was an instance of the tool turning, with the work stationary which proved very satisfactory.

Aluminum Castings Crown Pittsburgh Shrine

(*Concluded from Page* 296)

All sand used in the foundry is stored inside the building in large bins.

Molding sand is conveyed from the hoppers by an overhead belt system and distributed to small hoppers at each molding floor. Excess sand is conveyed to the end of the system where it is carried at right angles for a short distance and then is dropped to a pan conveyor which moves below the floor level, in the opposite direction to the distributing belt.

The pan conveyor below the floor traveling beneath open steel gratings acts as a return conveyor. The castings on each floor are shaken out on the gratings and the sand falls through to be returned to the screen and tempered.

After the castings are shaken out on the grating, they are placed on a moving steel plate conveyor which is level with the floor. This conveyor transports the castings to the cleaning room where the cores are knocked out, gates and risers removed and the castings are cleaned.

Perhaps the most important development in the aluminum casting industry to date has been that of heat treated castings. The Aluminum Co. of America maintains a department completely equipped for heat treating aluminum castings in large quantities.

Alloys of the heat treated type are used in castings requiring both strength and ductility. A rigid control not only of chemical composition and heat treament but more especially of the foundry technique is maintained at all times to insure a uniformly high quality product.

Officials of the Aluminum Co. of America regard the advent of aluminum castings into structural work optimistically and believe that this new field will expand rapidly.

Study Electric Furnace

(*Concluded from Page* 314)

Mr. Campbell gave a short reply in which he said that he had given his attention particularly to melting furnaces but there are many electric annealing furnaces working. He added that great progress is being made in the study of linings, but that the question has not yet reached the commercial stage. Referring to the size of resistance furnaces he stated that he sees no reason why furnaces of the induction type should not work satisfactorily with a capacity of over 67,200 pounds.

Fifteen other papers of a more scientific nature were presented at the meeting.

Fuller-Lehigh Co., Fullerton, Pa., has taken over the pulverized coal feeder, burner and water-cooled furnace wall business of the Bailey Meter Co., Cleveland.

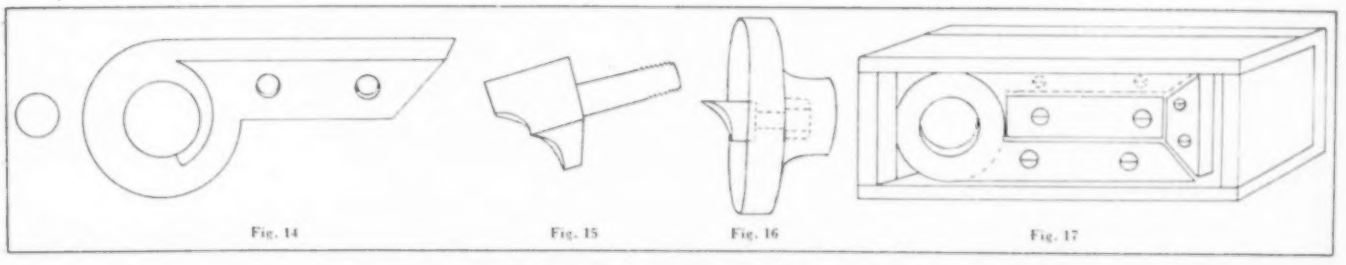


Fig. 14 Fig. 15 Fig. 16 Fig. 17

FIGS. 14 TO 17—A CURVED SURFACE WAS PRODUCED WITH A TOOL FASTENED ON A FACE PLATE

He Sailed Away from Clyde *Forty Years Ago*

NATURAL instinct or intuition with which every healthy Scot seems to be endowed at birth sent John Alexander early in life into a job that just suited him. Only a few months ago he retired from the position of foundry and pattern shop manager of the Cochrane Corp., Philadelphia, known for many years as the Harrison Safety Boiler Works. The years in between represent a fairly long span and approach closely the three score and ten popularly supposed to constitute what a man may expect, barring strikes, fires, accidents and the will of God. The early years, the formative years, the years in which he laid the foundations broad and deep for the pedestal that afterward supported him as a master foundryman, were spent in the famous engineering nursery along Clyde bank where men learn to build the giant engines and other prime movers that constitute the great throbbing heart of industry afloat and ashore. He spent 12 years—well, perhaps spent is not the proper word—he invested 12 years of his time in the gilt edged bonds of knowledge and then, properly equipped with a good working capital, he set out as so many of his countrymen have done before and since, to seek his fortune beyond the wide salt sea in the Eldorado of the West.

On March 17, 1887, he sailed out of the old home port of Glasgow and watched the familiar sights slipping past one by one. In a few short hours the churning screw had carried him out of sight of his native land, the home of his childhood associations and the dwelling place of his people since before Caesar's foreign legions first set foot in Britain. He landed in New York March 31 and proceeded next day to Philadelphia, where he has remained ever since.

John was born April 5, 1861, in that part of Glasgow, Scotland known as Partick and received his early education in the public schools and in Wylie's Partick academy. By the time he was almost 14, to wit: Nov. 2, 1874, he decided he had wasted enough time in the classic halls of learning. He began an apprenticeship with Thos. Wingate & Sons and afterward finished with Fleming & Ferguson, shipbuilding and engineering firms on the river Clyde, graun' places, if ony pairson should ask ye, for developing the engineering instinct. He supplemented his practical shop training by attending an applied mechanic's school in the evening.

With time hanging heavy on his hands between the ages of 15 and 16 he built a small brass, horizontal engine with a cylinder 1⅞-inch bore and 3-inch stroke. In the drawing room he laid out miniature propeller wheels 5 to 11-inch diameter and then set up a loam molding rig at home where the molds were swept in potter's clay, dried in the family oven and poured with plaster of Paris. After they had been finished and varnished they made desirable ornaments. The gentleman who finds mischief still for idle hands to do passed John up as a total loss. He served an all around apprenticeship of three years in the drawing room, three months in the machine shop and five years in the foundry and pattern shop. Part of the time he was foreman in the foundry and pattern shop and checker over the draftsmen. He continued in the latter position for five years with jurisdiction over the pattern shop and foundry. Also he looked after the work in four outside foundries where castings were made for his firm. He did not spend any time gathering daisies by the wayside. In America the young man secured employment with Wm. Cramp & Sons, at that time operating what was regarded as the finest shipyard on the Atlantic coast. He remained three years and then divided the following four years between the old Morris-Tasker works and the Baldwin Locomotive Works. In 1894 he assumed charge of the foundry and pattern shop of the Harrison Safety Boiler Works and continued as superintendent until his retirement in August, 1926, after 32 years continuous service.

Shortly after he joined the Harrison Safety Boiler Works, the company moved its foundry and pattern departments to Norristown where larger quarters were available and where the working force was greatly increased. Thirty-eight carloads of patterns and rigging were moved at that time and the first heat was poured in Norristown four days afterward.

Mr. Alexander always has been an enthusiastic member of the Philadelphia Foundrymen's association and has presented several papers at the meetings including one recently, advocating the repair by welding of the Liberty bell now lying cracked and useless in Independence Hall. This paper attracted considerable attention at the time and was the subject of comment among many who were not connected with the foundry industry.

Adventures? None. In the summer of 1925 he was held up by three bandits, but he modestly claims the wee bit siller he made on that deal hardly paid for his time.

WHAT OTHERS ARE THINKING

Abstracts Selected from the World's Foundry Literature

Making Cupola Malleable

Black Heart Malleable Practice and the Cupola, by C. Kluystmans, paper read at a meeting of the Association Amicale et Mutuelle de Fonderie, *La Fonderie Moderne*, Paris, February 1927.

The author deals with the manufacture of black heart malleable with the use of steel scrap in a cupola of 600 millimeters or about 23.5 inches diameter with one row of four tuyeres. The relation between the total section of the tuyeres and the area of the cupola at the melting zone is one-tenth.

The following points are discussed:

(1) the volume of air blown into the cupola must be calculated for the output capacity of the cupola.

(2) The pressure of the air must be sufficient to reach the center of the cupola and produce a definite oxidation; the pressure may vary during the period of operation of the cupola.

(3) The charges must be calculated closely. In malleable practice losses are higher than in ordinary practice and the lower the ultimate carbon content the higher the losses will be. If more than one cupola is being operated the charges must be calculated separately for each one. Exception is taken to European practice where no annealed malleable scrap is used. It is pointed out that thermit welded scrap should be eliminated owing to the presence of aluminum which favors the formation of graphite.

(4) The coke used for lighting the cupola should be dry and charged in large selected lumps. It should be calculated in volume sufficient to reach the melting zone in the cupola in order that the molten metal should reach the tapping hole 15 minutes after the blast has been put on.

(5) Special precautions should be taken to obtain perfect lighting of the cupola in order that the melting zone should be at the proper place.

(6) The metal should be hot, between 1400 and 1450 degrees Cent.

(7) The composition of the metal should be constant.

(8) The losses taken up by gas should be reduced to the minimum.

(9) The cost of production should be as low as possible. The author shows that black heart malleable iron made in the cupola costs less to produce than in the air furnace and even less than European malleable iron.

Influence of Phosphorus

Influence of the Phosphorus Content of Cast Iron on the Resistance to Compression and Tensile Stresses, by W. E. Dennison, *Foundry Trade Journal*, March 17, 1927.

Some experiments were carried out to determine the effect of increasing the content of phosphorus in cast iron. A mixture with an average analysis of: Silicon, 2.03; total carbon, 2.83; phosphorus, 0.65; sulphur, 0.046 and manganese, 0.72 per cent was melted in a cupola and was followed by a mixture with the following average analysis: Silicon, 2.35; total carbon, 2.89; phosphorus, 1.22; sulphur, 0.04 and manganese, 0.64. Seven test bars were taken during the changeover period and these bars showed slight variations in the silicon, carbon, sulphur and manganese contents. The phosphorus content gradually increased from 0.79 per cent in the first bar to 1.20 per cent in the seventh in increments of about 0.07 per cent for each bar. Periods between bars are not stated. Compression tests showed a gradual reduction of compression strength for each increase of phosphorus. Tensile strength remained constant with phosphorus from 0.8 to 1.0 per cent and a slight but steady depreciation to 1.2 per cent phosphorus.

Traces Foundry History

The Evolution of the Foundry Industry Since 1900. Leon Thomas, president of the Association Technique de Fonderie, in a paper presented at a recent meeting of the association (l'Usine, Paris, Feb. 26, 1927) reviewed the progress made in the foundry during the past 26 years.

Two industries have largely contributed to this progress, central heating and the manufacture of automobiles. In the lay-out of foundries the modern solution is to erect foundries with two or three floors to take advantage of handling materials by gravity. Concrete buildings are recommended. The quality of raw materials has not greatly improved since the beginning of the century. It is desirable that foundrymen should have a guarantee of the carbon content of low carbon pig iron. The tendency now is to make cores with white sand rich in silicate, which is abundant in the Paris district. Linseed oil is considered as one of the best binders. In recent years fuel oil has come into use for heating ovens and pulverized coal for certain furnaces; it would be interesting to use gas as a fuel, but little experimenting has been done in that direction.

Laboratories are being more extensively used and there now is the international committee of testing methods. The need of an inexpensive pyrometer capable of measuring temperatures exceeding 1200 degrees Cent. is felt. Researches still are being made to measure the temperature at the bottom of the cupola. The quality of cast iron has improved and it now is possible to obtain during an 8-hour shift metal of a constant quality which permits the casting of 600 automobile cylinders with only 2 or 3 per cent defectives due to the cast iron. This is only possible with close control of the burden and of the working of the cupola. The addition of certain metals, such as nickel, to the molten iron improves its qualities.

It seems that the uses of cast steel could be expanded. It is to be hoped that an intermediate metal may be found combining the characteristics of cast iron and steel. The development of malleable iron is surveyed and a comparison is made between American and European practice. The progress in light alloys and brass founding is reviewed.

Little change has been made in the general features of the cupola furnace. The Germans are about the only partisans of the fore hearths. The development of malleable iron practice has renewed the interest in open-hearth furnaces which give pure metal. Electric furnaces are recommended where cheap current is available. Considerable improvements have been made in the construction of drying ovens and re-heating furnaces. The latter now are generally heated with pulverized coal or gas. The sand-handling machines still can be improved. It should be possible to use the same sand indefinitely after it has been properly regenerated. The molding machine has reached its highest degree of efficiency but its use should be adapted to the work while, on the other hand, the operations made around the machine should be coordinated to take full advantage of its efficiency.

Core making has developed and has substantially improved. The cleaning of castings often is done by sand-blast equipment. The use of pneumatic tools is extending. The question of transportation of materials is of primary importance and mechanical means should be extensively used. Referring to production foundries and organization of work, M. Thomas, who is the manager of the Citroen foundries, stated that at one time 1200 men were employed who produced castings for 120 cars per day. At present 1000 men produce castings for 250 cars per day and it is hoped that the same number of workmen will turn out castings for 500 cars per day. The production cost does not decrease in proportion, but the saving of labor is important in France where normally there is a shortage.

Classifies Cast Steel

Cast Steel, by E. Oberg et Monfray. *La Revue de Fonderie Moderne*, Paris, March 10, 1927.

Various grades of steel are classified according to their physical properties. The recommendations of the American Society for Testing Materials for reheating steel castings are quoted. The composition of steel as recommended by the French society of automobile manufacturers is given. Compositions recommended in Germany for light castings, heavy castings, marine castings and castings for crushing mills also are given. Reference is made to manganese steel.

The Shakeout

DAN M. AVEY, Editor

PAT DWYER, Engineering Editor
FRANK G. STEINEBACH, Associate Editor

CHARLES VICKERS, Nonferrous Editor
EDWIN BREMER, Associate Editor

¶ Chicago Beckons

TIME is getting shorter every day before the foundrymen of the country assemble in Chicago for their annual convention, for the discussion of papers covering development of the industry along many lines, for the mutual exchange of information, for the renewal of old and the formation of new friendships and finally to enjoy to some extent the hospitality for which Chicago is famous. The coming convention without an attendant exhibition is more or less an experiment, but there is no apparent reason why it should not prove as successful as similar conventions held from time to time by other technical associations. At one time the charge of laxity on the part of foundry organizations might be advanced with a certain degree of justification, but in recent years the technical features of the industry have received their full share of attention.

AMONG the many features to be presented it is fairly certain that the session dealing with the additions of scrap to the blast furnace burden will merit the closest attention particularly among foundrymen engaged in the production of gray iron castings. Many points that have caused controversy and misunderstanding between buyers and sellers of pig iron will be ironed out satisfactorily. This is a question that dates back approximately to the war years and one that has been growing more acute year by year since that time. A thorough airing of the subject from both sides by men who are qualified, will mark an important step on the way to understanding. The wobbly and inexperienced driver is the man who causes the traffic jams and the accidents.

CHICAGO is an ideal city for a convention whether regarded from the angle of geographical location, accessibility, hotel accommodation, points of interest or simply because it is the greatest foundry center on the North American continent with approximately 200 casting shops within the corporate limits of the city and with 270 in the metropolitan district. Technical sessions, social features and a visiting program promise an exceedingly strenuous and enjoyable time for the large and enthusiastic crowd that will be in attendance from June 6 to 9.

¶ Gentle, Grafters, Reincarnated

IN THE not distant past, the order for a crayon enlargement which the farmer and his wife signed for the suave salesman in the old front parlor, often appeared later in the form of a promissory note discounted at the local bank. Some might hold that in this enlightened age, such practices are gone forever, but such is not the case.

IN A recent circular broadcast by the National Association of Purchasing Agents, a new form of the old graft with manufacturers as the victims, is mentioned. Certain salesmen, representing irresponsible European concerns, have appeared striving to interest manufacturers in certain commodities, notably tool and alloy steels, files, metallic packing and similar sundries. These suave gentlemen, last survivors of the green goods era, have secured small trial orders for such items. Perhaps a month or more later the customer is startled by the arrival of several large packing cases awaiting delivery from abroad accompanied by a sight draft with invoice attached. The obvious move would be to refuse the shipment and protest the draft, but the invoice on examination is found to be authentic and the order for a large quantity of the material is signed in due form by the customer's representative. A clever arrangement of quantities in vertical and horizontal columns has resulted in the buyer ordering much more than he imagined. The remedy lies in reading carefully any documents presented for signature. Look well beneath for hidden catches of this nature.

The first operations of these men, who might be termed order raisers, have been among the manufacturing centers bordering on the Great Lakes. However, recent reports indicate that their attentions have been turned to the southwestern states. Watch for them.

Payment will be made for all contributions on foundry and pattern shop practice suitable for publication

Note—This sheet may be cut into two sections, 5 x 7 inches, and may be readily bound in note book form.

A LEXICON OF TECHNICAL TERMS

(*Continued from Data Sheet No.* 662)

Primary Valence

The number of bonds uniting an element with another in chemical bond. It is usually referred to hydrogen and is stated as the number of atoms of hydrogen it is capable of combining with or replacing.

Secondary Valence

Forces which cause molecules to combine into crystalline aggregates are called secondary valence. Secondary valence forces may serve to unite like and unlike molecules as well as with like, e. g., NaCl, $2H_2O$. The intermetallic compounds, Fe_3C, Fe_3P, etc., present in our common alloys may be satisfied by this secondary valence hypothesis.

Adhesion

The property of molecules or atoms to attract certain unlike molecules or atoms in any substance. This is a characteristic property of the molecules or atoms of all matter.

Cohesion

The property of molecules or atoms to attract like molecules or atoms in any substance. This is a characteristic property of the molecules or atoms of all matter.

Amorphous

Material having no crystalline structure is said to be amorphous or noncrystalline. Recent authorities seem to discount the possibility of there being such a form of matter. They seem to think all matter is at least in part crystalline, because of the nature of the atomic forces.

Crystalline

Material having a regular characteristic molecular structure or atomic arrangement. This is a general property of all matter to arrange itself according to some geometric pattern. All the alloys of the iron-carbon series are markedly crystalline.

Isotropic

A body of substance which possesses the same properties in all directions. None of the iron carbon alloys is isotropic, although some of the heat treated ones approach it somewhat.

(*Continued on Data Sheet No.* 666)

A LEXICON OF TECHNICAL TERMS

(*Continued from Data Sheet No.* 665)

Anisotropic (Acolotropic or Eolotropic)

A body or substance which possesses different properties in different directions. Iron-carbon alloys are generally considered anisotropic.

Homogeneous

A substance is said to be homogeneous when all its constituents have similar properties or characteristics. The only commercial metallic materials which would be considered homogeneous are those with either 100 per cent pure metal constituents or 100 per cent solid solution constituent.

Heterogeneous

A substance is said to be heterogeneous when it is composed of a mass of constituents which have dissimilar properties. Most of the commercial alloys and metals are heterogeneous. The only exceptions would be those in pure metal or solid solution state.

Stable Properties

Properties or constituents are said to be stable when they are difficult to change. If they are stable only under limiting conditions they are said to be *metastable properties.*

Example: Combined carbon exists at ordinary room temperature but at high temperatures it is easily decomposed, therefore combined carbon is a *metastable* constituent. On the other hand graphite exists at all temperatures and is therefore considered a *stable* constituent.

Equilibrium

When the forces or conditions under consideration are equally balanced for and against each other (positively and negatively) it is considered as a state of equilibrium. In metallography that which can exist under the given conditions is said to be *stable equilibrium*, otherwise it is *unstable equilibrium.*

Inertia

This is a general property of all matter to resist any attempt to change its state of rest or motion.

(*Continued on Data Sheet No.* 667)

Seeing America with The Foundry

Little Journeys to the homes of our readers

FLORIDA has a total of 24 foundries of which

22 Melt Gray Iron
2 Exclusive Nonferrous
20 Nonferrous Depts. of other foundries
1 Melt Steel
20 Melt Aluminum

FLORIDA—the "Peninsula State" is the winter playground of Americans east of the Mississippi River. The state is a peninsula 450 miles in length from north to south—nearly half the distance from New York to Chicago; the central part of the state is about 100 miles in width and the coast line of 1200 miles exceeds that of any other state.

Agriculture is the leading industry and for this purpose the state may be considered in three divisions, Northern, Middle and Southern Florida. Northern Florida includes that part of the state extending south as far as Saint Augustine. It produces rice, potatoes, tobacco, figs, peaches and sea-island and short staple cotton. Middle Florida extends from Saint Augustine to Tampa Bay and this region produces considerable cotton, oranges, lemons and numerous small fruits. Southern Florida produces bananas, sugar cane, grape fruit and pineapples. The cultivation and export of oranges is an important industry.

The principal manufactures are lumber and forest products, tar, turpentine and resin. Exceeding lumber in importance is the manufacture of cigars, which industry has its center at Tampa. The manufacturer uses tobacco raised in Florida and great quantities imported from Cuba.

It is interesting to know however, that in spite of Florida being thought of only as a vacation state, there are at present twenty-four foundries in operation.

In FLORIDA—THE FOUNDRY has 32 paid subscribers.

"Wherever metals are cast you'll find THE FOUNDRY"

Trade Trends in Tabloid

RAILWAY purchases have subsided after the temporary revival during February. The March sales of freight cars were only slightly in excess of 4600, while locomotive unfilled orders also registered a decline. Automotive work is advancing and foundries making this class of castings are busy. The production of pig iron for March attained a new high point, according to the *Iron Trade Review* which gives the total of 3,482,223 tons, compared with 2,940,604 tons for the preceding month. On a daily average basis, the production for March was about 7 per cent ahead of February. Merchant iron production increased from 642,804 tons in February to 762,354 tons for March. Foundry operations in general are improving. The malleable industry, according to the department of commerce operated at 60.3 per cent of capacity during February, compared with 48.1 per cent in January, and a steady increase has been shown since late last fall. Business conditions in general are favorable, although building is lagging behind last year. Average monthly prices for nonferrous metals during March according to New York reports in the *Daily Metal Trade*, follow: Casting copper, 12.998c; electrolytic copper, 13.336c; Straits tin, 69.35c; lead, 7.585c; antimony, 12.761c; aluminum, foundry ingot, 25.625c. Zinc averaged 6.705c, E. St. Louis, Ill., during March.

RAW MATERIAL PRICES

Iron

April 7, 1927

No. 2 foundry, Valley	$19.00
No. 2 southern, Birmingham	18.00
No. 2 foundry, Chicago	20.00
No. 2 foundry, Philadelphia	21.76
No. 2 foundry, Buffalo	17.50 to 18.00
Basic, Valley	19.00
Basic, Buffalo	17.00 to 17.50
Malleable, Chicago	20.00
Malleable, Buffalo	17.50 to 18.00

Coke

Connellsville foundry coke	$4.25 to 5.00
Wise county foundry coke	6.00

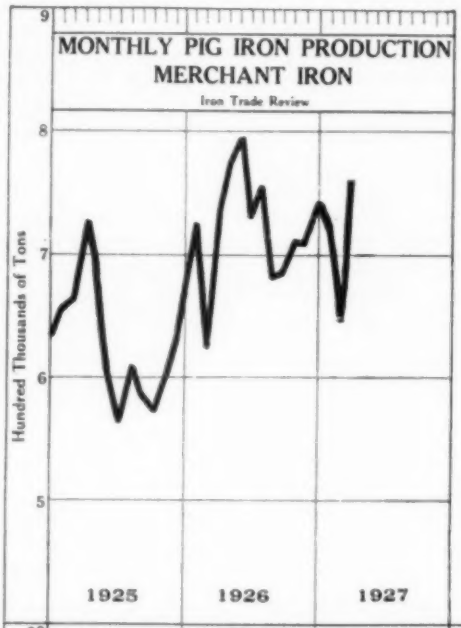
Scrap

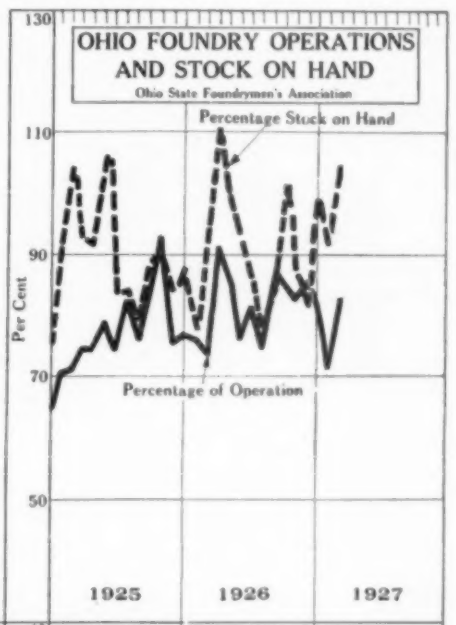
Heavy melting steel, Valley	$17.00
Heavy melting steel, Pitts.	16.50 to 17.00
Heavy melting steel, Chicago	13.50 to 13.75
Stove plate, Chicago	13.50 to 14.00
No. 1 cast, New York	14.00 to 14.50
No. 1 cast, Chicago	16.50 to 17.00
No. 1 cast, Philadelphia	17.00 to 18.00
No. 1 cast, Pittsburgh	16.00 to 16.50
No. 1 cast, Birmingham	15.00 to 16.00
No. 1 cast, Buffalo	16.00 to 16.50
Car wheels, iron, Pittsburgh	16.00 to 16.50
Car wheels, iron, Chicago	15.00 to 15.50
Railroad malleable, Chicago	16.00 to 16.50
Agricultural, Mal., Chicago	14.75 to 15.25
Malleable, Buffalo	17.00 to 17.50
Railroad, malleable, Pitts	16.50 to 17.00

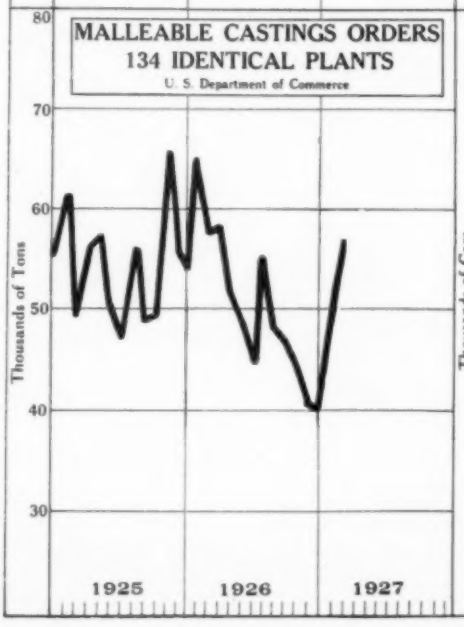
Nonferrous Metals

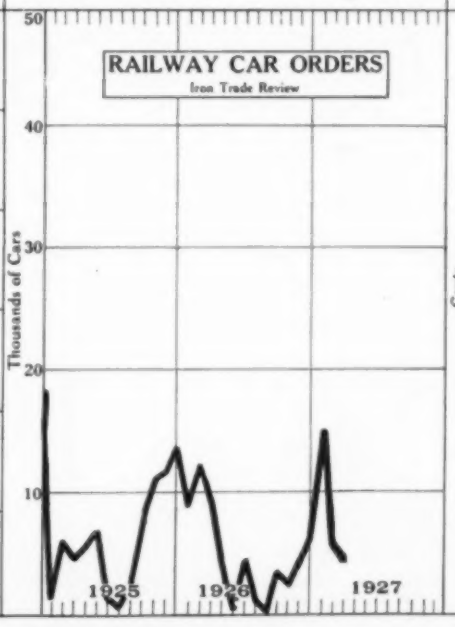
Cents per pound

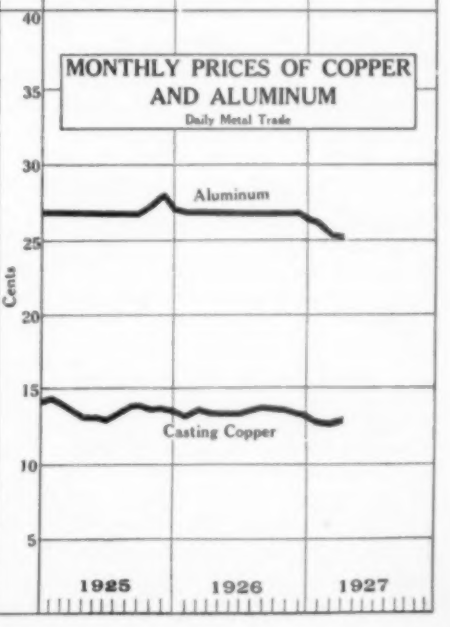
Casting copper, refinery	12.75 to 12.87½
Electro copper, producers	13.12½
Straits tin	69.37½ to 69.50
Lead, New York	7.25
Antimony, New York	13.25
Nickel, electro	39.00
Aluminum, No. 12, prod'rs	24.50
Aluminum, No. 12 remelt	20.50
Zinc, E. St. Louis, Ill.	6.52½ to 6.55











Personal

ARTHUR G. HOPCRAFT, purchasing agent of the Ferro Machine & Foundry Co., Cleveland, has resigned to accept a position as head of the division of purchasing and stores of the City of Cleveland. Mr. Hopcraft is a member of the National Purchasing Agents association and served as vice president of that organization in 1923. He was elected president of the association in 1924. He also served as president of the Cleveland Purchasing Agents association during 1923 and 1924. Mr. Hopcraft has been connected with the Ferro company for the past 11 years. Previous to that time he was in the purchasing agent's department of the Peerless Motor Car Co., Cleveland for 5 years. Before his association with the Peerless company he had been connected with the W. Bingham Co., Cleveland for 5 years. Mr. Hopcraft will have full charge of city purchasing and of the supply rooms and stores of every department controlled by the municipal government.

E. J. Schulte has been made superintendent of the Schulte Brass Mfg. Co., Norwood, O. He formerly was superintendent of the Trojan Brass Mfg. Co., Cincinnati.

M. B. Bartlett has been appointed sales manager of the Midwest Casting Co., Middletown, O., maker of malleable iron castings. He formerly was connected with the Peerless Malleable Castings Co., Toledo, O.

Burns W. Steeves, formerly foundry superintendent of the Farrel Foundry & Machine Co., Ansonia, Conn., recently resigned to occupy the same position with the Torrington Co., Torrington, Conn.

Harry F. Hayne, formerly metallurgist for the Interstate Foundry Co., Cleveland, and later connected with the William H. Nicholls Co. Inc., Brooklyn, and the Warren Foundry & Machine Co., Warren, O., at present is superintendent of the Crown Pipe & Foundry Co., Jackson, O. The latter company manufactures soil pipe and fittings.

W. S. Hovey has been elected president of Fairbanks, Morse & Co., Chicago, succeeding C. H. Morse, who becomes chairman of the board. This is the first time that any one outside of the original Morse family has been elected president. Mr. Hovey, who is a graduate of Cornell, entered the service of the Sheffield Car Co. an affiliate of Fairbanks, Morse & Co. in 1902, as assistant superintendent. He was made vice president of the latter organization in 1919.

Observe Anniversary

L. S. Brown, Springfield, Mass., and Daytona Beach, Fla., with Mrs. Brown celebrated a fiftieth wedding anniversary recently at their winter home in Florida. The local Rotary club made this a special occasion and presented Mr. and Mrs. Brown with numerous gifts. Remembrances also were forwarded from the Springfield Rotary club.

ARTHUR G. HOPCRAFT

Mr. Brown started the manufacture of foundry facings many years ago in Willimansett, Mass. Cultivating the sources for charcoal to be ground into facings, Mr. Brown developed a large sale of this commodity in lump form. He is widely known throughout the New England foundry district for his cultivation of the foundry facing business.

Foreign Foundry Papers Are Amalgamated

The *Revue de Fonderie* of Belgium recently has been amalgamated with *La Fonderie Moderne*, Paris, France, and the new publication will be known as *La Revue de Fonderie Moderne*. The new publication will be published by *La Fonderie Moderne* and will appear twice a month.

The Pittsburgh Malleable Iron Co., Pittsburgh, has commenced operations in its steel foundry making electric steel castings.

Obituary

J. A. Buckwalter, president, Buckwalter Stove Co., Royersford, Pa., died recently at his home in that city.

Henry Deringer, a member of the firm Spindler & Deringer, Jersey City, N. J., brass founders, died at his home in Brooklyn, N. Y., recently.

Erastus R. Fritzinger, 70 years old, manager of the Decatur Foundry, Furnace & Machine Co., Decatur, Ind., was fatally injured recently when a freight train struck his automobile.

Lucius H. Goff, 88, an old-time bell maker, died recently at his home in East Hampton, Conn. Mr. Goff was employed continuously by the East Hampton Bell Co. for the past 75 years, serving as workman, superintendent, factory manager and salesman.

Robert J. Walker, 57, died recently at his home in Los Angeles where he had resided for the past five years. Mr. Walker was foreman of the W. B. Huber Piston Co., Los Angeles, for three and one half years. Previous to that time he was connected with the American Steel & Wire Co., Cleveland, the Interstate Foundry Co., Cleveland, and with foundry interests in Anderson, Ind., Grand Rapids and Milan, Mich. The last mentioned connection was with the Detroit Heater Co. of that city where he was employed for three and one half years.

To Talk on Sand

At the meeting of the Central New York State Foundrymen's association which will be held at Syracuse, N. Y. on April 22, H. B. Hanley, Whitehead Bros. Co., Rochester, N. Y., and Benjamin D. Fuller, Whitehead Bros. Co., Cleveland, will present addresses on foundry sands.

Issue Pamphlet

All steel casting producers who are members of the American Foundrymen's association are listed in a special pamphlet which recently has been issued. Nearly 60 per cent of the steel casting plants of the United States and Canada are members. The list numbers 174 plants in the United States, 12 in Canada and 13 in foreign countries.

Frank J. Donnelly has joined the New York office of the Botfield Refractories Co., Philadelphia, and will cover the New Jersey territory under the direction of C. C. Phillips, district manager.

Prevent Stove Casting from Cracking

Question: Is it possible and practical to make stove plate patterns such as end shelves and closet fronts in such a manner that the castings will come straight and true without a crack or a warp? What do you think of butting the sand between the bars after the casting is poured as a remedial measure?

Answer: To the first part of your question we can say yes, it is possible and practical to make patterns for shelves and high closet fronts that will not cause the castings to crack and warp. The proof of this is that these castings constantly are made successfully. As for suggesting a remedy or a course of action for your present trouble, that is a more complicated problem. So many factors exert a direct mearing on the subject that a personal examination would be necessary before a person could arrive at a decision and prescribe a remedy. In some cases the shape of the pattern is directly responsible for warped castings and the remedy you refer to, ramming the molds afterward, is employed to prevent this condition. In some instances the iron is responsible for trouble, particularly cracked castings but usually warped castings and cracked castings can be traced to faulty gates.

The National Smelting Co., Cleveland has opened an office at 299 Madison avenue, New York. Ben S. Rosenberg will be the firm's sales representative and will cover New York, New Jersey, Maryland, Delaware and eastern Pennsylvania.

Faked Foundry Facts

A High Blast

Iron for Ice Machines

Question: What mixture should we use for making ammonia fittings and pumps for ice machines? We are making these castings now and have a large percentage of them which leak under pressure.

Answer: A good mixture for semisteel for ammonia fittings and pump and ice machine castings would consist of about 40 per cent return scrap, 12 per cent steel scrap and the remainder pig iron. The steel scrap should be added on top of the coke and should be of a fairly heavy section but not too thick. Short rail lengths answer well for this purpose. Pig iron should be added on top of the steel scrap after which the gray-iron scrap can be put on the charge. The iron should be of such a composition that the finished casting contains 1.75 to 2.25 per cent silicon depending upon the thickness of the section. Sulphur should be kept below 0.12 per cent, and manganese between 0.6 and 0.8 per cent. It is essential that the phosphorus be kept below 0.3 per cent and preferably about 0.2 per cent to obtain the best results.

S. R. Keith has been appointed manager of the Inert Metal Products Inc., Stuyvesant Falls, N. Y.

Foundry Association Directory

American Foundrymen's Association

President, S. W. UTLEY, Detroit Steel Casting Co., Detroit; secretary-treasurer, C. E. HOYT, 140 South Dearborn street, Chicago; technical secretary, R. E. KENNEDY, 909 W. California street, Urbana, Ill.

The Buffalo Foundrymen
Buffalo

President, J. MCARTHUR, Washington Iron Works; secretary, W. J. WARK, E. J. Woodison Co., 146 Chandler street. Meetings the third Wednesday of the month at 146 Chandler street.

Chicago Foundrymen's Club
Chicago

President, G. H. ROLINSON, American Brake Shoe & Foundry Co.; secretary, ALBERT N. WALLIN, S. Obermayer Co., 2563 W. Eighteenth street. Meetings second Saturday in each month at the City club, 315 Plymouth court.

Connecticut Foundrymen's Association

President, FRED W. STICKLE, Capitol Foundry Co., Hartford, Conn.; secretary, C. S. NEUMANN, Union Mfg. Co., New Britain, Conn. Meetings are on second Friday of each month in various parts of the state.

Detroit Foundrymen's Association
Detroit

President, ROBERT G. CRAWFORD, Atlas Foundry Co., 131 Artillery street, Detroit; secretary, RUSSELL M. SCOTT, Packard Motor Co., 1580 East Grand boulevard, Detroit. Meetings third Thursday in each month at the Union League club, 35 Grand River avenue, Detroit.

Metropolitan Brass Founders' Association
New York

President, WILLIAM EMBER, Jefferson Brass Foundry, 62 Delevan street, Brooklyn, N. Y.; secretary WILLIAM E. PAULSON, Thomas Paulson & Son Inc., 97 Second avenue, Brooklyn, N. Y. Meeting second Wednesday in each month at the Building Trades club, 34 West Thirty-third street, New York.

Newark Foundrymen's Association
Newark, N. J.

President, J. L. CARTER, Barlow Foundry Inc., Newark; secretary, W. H. MANTZ, Atlas Foundry Co., Irvington, N. J. Meeting called by president.

New England Foundrymen's Association

President, HENRY S. CHAFEE, Builders Iron Foundry, Providence, R. I.; secretary, FRED F. STOCKWELL, 205 Broadway, Cambridgeport, Mass. Meetings second Wednesday of each month at the Exchange club, Boston. Outings usually are held in the summer months.

Ohio State Foundrymen's Association

President, WALTER L. SEELBACH, Walworth Run Foundry Co., 2488 West Twenty-seventh street, Cleveland; secretary-manager, ARTHUR J. TUSCANY, 5713 Euclid avenue, Cleveland.

Philadelphia's Foundrymen's Association
Philadelphia

President, WALTER WOOD, R. D. Wood & Co., Philadelphia; secretary HOWARD EVANS, Union League club, Philadelphia. Meetings the second Wednesday of each month at the Manufacturers' club.

Pittsburgh Foundrymen's Association
Pittsburgh

President, LAWRENCE V. STEVENS, Locomotive Stoker Co. N. E. Pittsburgh; secretary-treasurer, WILLIAM J. BRANT, Wm. J. Brant, Bessemer building, Pittsburgh. Meeting on the third Monday of the month, except in July and August, at Fort Pitt hotel.

Quad-City Foundrymen's Association
Davenport, Iowa

President, J. H. DIEDRICH, Blackhawk Foundry & Machine Co., Davenport, Iowa; secretary-treasurer, A. D. ZIEBARTH, Davenport Foundry & Machine Co., Davenport, Iowa. Meetings the third Monday evening of each month, the meeting place being rotated between Moline, Rock Island and Davenport.

Southern Metal Trades Association
Atlanta, Ga.

President, GEORGE B. COCKER, Gastonia, N. C.; secretary, W. E. DUNN JR., Healy building, Atlanta, Ga.

Tri-City Technical Council
Moline, Ill.

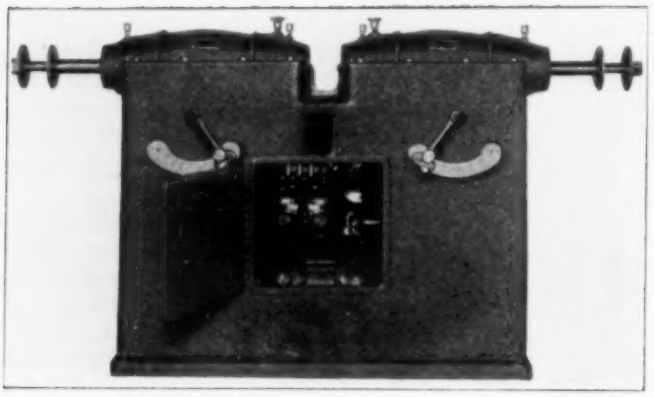
Chairman, H. BORNSTEIN, Deere & Co., Moline, Ill.; treasurer, MAX SKLOVSKY, Deere & Co., Moline, Ill. Combined meetings held only one or two times a year on call.

Tri-State Foundrymen's Association
Cincinnati

President, HAROLD P. RITTER, John A. Oberhelman Foundry Co., 3323 Colerain avenue; secretary, GEORGE W. PIEHL, Wessling Bros. Foundry Co., 1607 McLean avenue. Meetings the second Thursday of each month at the Cincinnati club, Eighth and Race streets.

Twin City Foundrymen's Association
Minneapolis-St. Paul

President, H. H. NOTT, Smith System Heating Co., Minneapolis; secretary-treasurer, C. E. LANGDON, 3849 Lyndale avenue, south, Minneapolis. Meetings monthly at the Athletic club.



THE SPEED IS REGULATED BY OPERATING THE SHIFT LEVERS

Buffing Machines Have Variable Speeds

The United States Electrical Tool Co., 2488 West Sixth street, Cincinnati, recently has introduced a double spindle, selective speed buffing and polishing machine. Any speed desired may be obtained by changing the motor pulley. Belt shift levers enable each operator to govern one spindle independently of the other, or to stop it entirely. This feature also permits the operator to change either buffing wheel when necessary without stopping production on the other wheel.

Constant belt tension is secured automatically by a steel idler roller. The motor is located in the base, as may be noted in the accompanying illustration. The spindles are nickel steel and run in heavy duty ball bearings. Five sizes of these buffing machines are built to use 3, 5, 7½, 10 and 15 horsepower.

Appointed Agent for Wood Milling Machine

The Oliver Machinery Co., Grand Rapids, Mich., has been appointed agent and distributor for the wood milling machine which is manufactured by Wadkin & Co., Leicester, England. The Oliver company acted as agent for the Wadkin company for a number of years but this agency was disrupted just prior to the war and no milling machines were imported for some time.

Recently the machine has been redesigned and a number of new features developed to facilitate exacting work, such as encountered in the patternshop. Attention also has been paid to the design of various tools and accessories which are supplied with the milling machine.

As may be noted in the accompanying illustration, which shows the milling machine in operation in a pattern shop, the heavy main frame supports the overhanging arm carrying the spindle. The arm is mounted on slideways on the main frame, and may be lowered or raised either by power or hand feed. The spindle head is carried by overhanging arm swivels between the vertical and horizontal in either direction. The principal angles are indexed and located by a spring plunger taper pin engaging in suitable holes. The work is held on a table which has two motions at right angles, both of which are operated by a screw and hand wheel. The table also has a rotary motion, thus providing a method of accomplishing circular work.

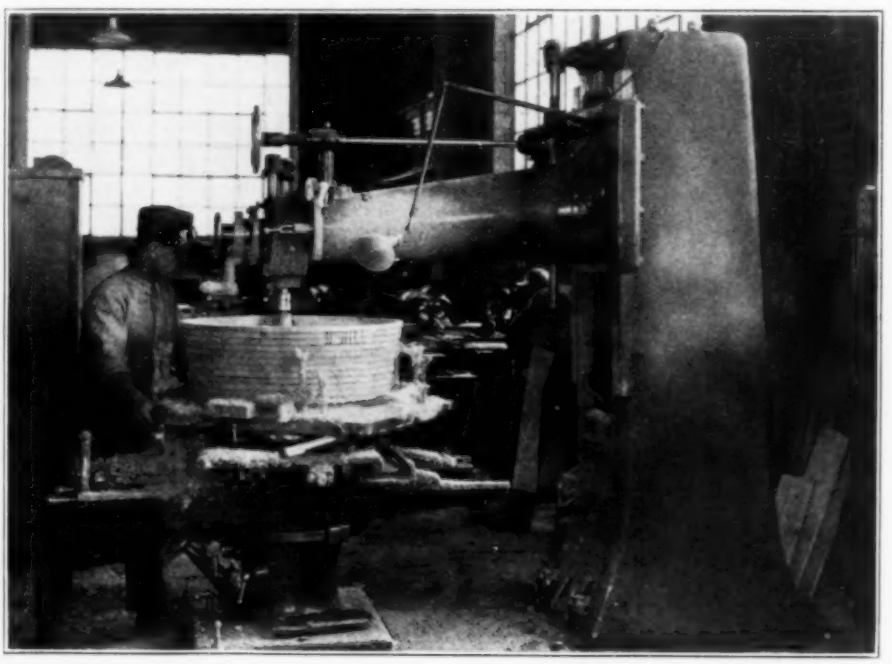
Catalog Describes Line of Foundry Supplies

A remarkably complete catalog of foundry equipment and supplies recently has been issued by Frederic B. Stevens Inc., Detroit. The 842 pages of the *Blue Book* contain complete information on foundry facings, supplies, equipment and fire brick, as well as buffing compositions, polishing and plating supplies and equipment. One of the early pages of the volume is devoted to a drawing of the elephant and the reasons for the choice of this design as the trademark. This is followed by descriptions of the Detroit plant and laboratory, the factory at Detroit and the various branch plants. The next section gives an interesting description of the various kinds of plumbago, facings, core washes and blackenings. The book is well illustrated both with drawings and reproductions of photographs which show the complete line of equipment handled by Frederic B. Stevens.

Large Castings Required for Eastern Tunnel

A heavy tonnage of iron and steel is required for the Fulton street tunnel, between Manhattan and Brooklyn, general contractors' bids on which will be opened by the board of transportation May 6. The largest item calls for 56,000 tons of segment castings, estimated in a previous issue as approximating 50,000 tons. Other items include 9000 tons of shapes, 900 tons of cast steel tunnel linings, 2000 tons of bolts, and miscellaneous assortment of pipe, running into several hundred tons. Of the Class A cast pipe required, there will be 8500 feet of 8-inch, 5000 feet of 3-inch, 400 feet of 4-inch, 100 feet of 6-inch and 100 feet of 10-inch.

Aggregate shipments of passenger automobiles and commercial vehicles by the General Motors Corp. in February totaled 124,426 against 99,367 in January and 91,313 in February, 1926.



THE MILLING MACHINE MAY BE USED IN THE PRODUCTION OF A VARIETY OF WORK IN THE PATTERN SHOP

Removes Eastern Office

The Pittsburgh Testing Laboratory, inspecting engineers and chemists, announces the removal of its offices from 50 Church street and its laboratory from 35 Eighth avenue, New York city, to its new laboratory and offices located at 72 Washington street, New York city. The most improved type of accurate physical testing machines and chemical apparatus have been installed. The facilities have been greatly improved and the scope of service enlarged to better serve its clients.

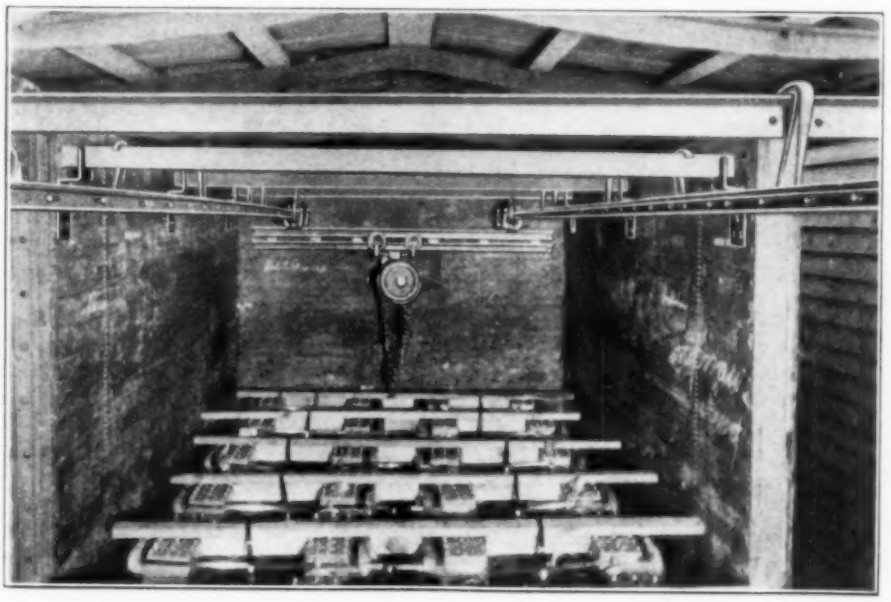
This company, whose main office is in Pittsburgh, has branch offices located in all of the principal cities of the United States, as well as facilities for inspection and testing abroad.

Monorail System Is Used To Load Box Cars

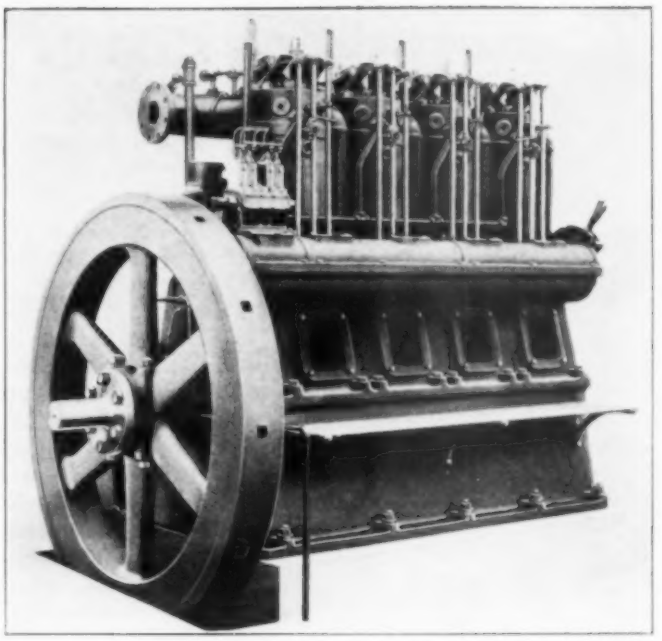
The American Monorail Co., West 67 and Pear avenue, Cleveland, recently has introduced monorail conveying equipment which may be fitted to a box car and used in loading and unloading materials. The equipment, which is shown in the accompanying illustration, may be assembled in a car in approximately 15 minutes and may be dismantled and removed in a few minutes. No permanent extra fittings are required in the car and since all parts of the equipment are suspended near the roof, they may be removed readily from loaded cars.

To prepare the box car to receive the monorail loader, a series of steel brackets having an offset bend toward the upper end and provided with slotted holes at the lower end, are nailed along the sides of the interior of the car. A series of transverse stringers are slipped into the upper slots of these brackets. The stringers support the hangers carrying the rails for the crane bridge. The loader consists of a short transfer crane assembly operating on two parallel lines of crane runway extending the full length of the car. The crane bridge is carried by specially designed trolleys in a manner which gives maximum head room. The standard loader is adjustable for cars from 36 to 40 feet in length and the stringers supporting the crane runways are adjustable to correspond to the different car widths.

The box car is spotted opposite the projecting end of the loading platform monorail system. The crane bridge then is moved to the car door and placed in alignment with the projecting end of the loading platform monorail and is latched in place. The loaded trolley then is run from the shipping department over the loading platform monorail directly on to the crane bridge in the car. The latch on the crane bridge is released and the load is moved to the desired point in the car and lowered. The box car loader has a capacity of 4000 pounds.



THE LOAD IS CARRIED DIRECTLY FROM THE SHIPPING ROOM TO THE CAR ON THE MONORAIL



NUMEROUS IMPROVEMENTS HAVE BEEN MADE IN THE DESIGN OF THE DIESEL ENGINE

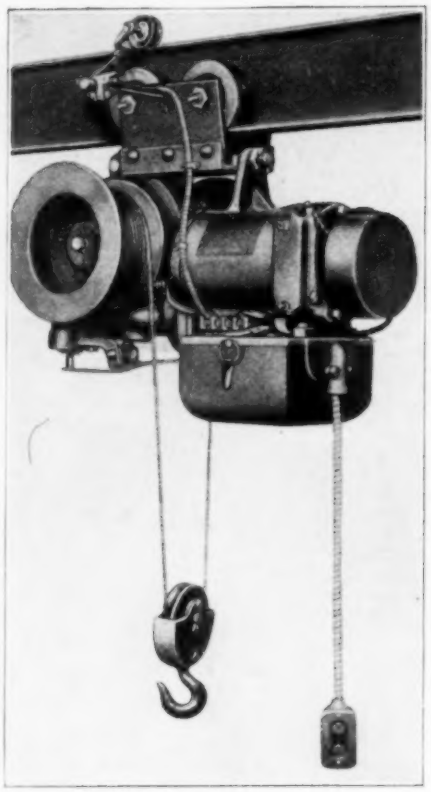
Secures Right To Build Diesel Engines

A new line of diesel engines ranging in capacity from 80 to 240 horsepower, now is being marketed by the Chicago Pneumatic Tool Co., 6 East 44th street, New York. Rights for the manufacture of this engine have been obtained from Motoren Werke, Mannheim, Germany. The engine is of the Benz type, which has been further developed and improved during the past few years. A view of the diesel engine which is being marketed by the Chicago Pneumatic Tool Co., is shown in the above illustration.

Issues Valuable Booklet on Refractories

The seventh edition of the booklet, "Brands of Firebrick and Other Refractories," now is being distributed by the American Refractories institute which compiled the material. In addition to the alphabetical list by brand name, the booklet has an alphabetical list of manufacturers in the United States and Canada with the location of plants, and a third list according to states. Copies of the booklet may be obtained from the institute, 2202 Oliver building, Pittsburgh.

Milwaukee Foundry Equipment Co., Milwaukee, has appointed C. W. Coleman, London, England, as its sole European representative.



THE HOISTS ARE MADE WITH CAPACITIES FROM ¼ TO 6 TONS

Shepard Company Buys Hoist Business

The Shepard Electric Crane & Hoist Co., 360 Schuyler avenue, Montour Falls, N. Y., has purchased the right to manufacture and sell all of the products formerly made by the Sprague Electric Works of the General Electric Co. The Shepard company will carry on the manufacture of the line of products at the Montour Falls plant. This line includes worm gear electric hoists and trolleys in capacities from ¼ to 6 tons and having push button and rope control; worm and spur gear winches in capacities from 1 to 6 tons, and repair parts for all types of hoists, trolleys and winches sold formerly by the Sprague Electric works.

The Sprague Electric Hoist division of the Shepard Electric Crane & Hoist Co., has been formed with headquarters at 30 Church street, New York, to handle exclusively the sale of the newly acquired line of hoists and winches. N. A. Hall, associated with the General Electric Co., for 14 years, will have charge of this new Shepard division.

The department of manufacture of the United States chamber of commerce recently has published a pamphlet on the "Evolution of Overhead Accounting." The pamphlet is divided into two sections. The first is devoted to the history of overhead accounting and the second offers some suggestions in improving accounting procedure. Copies of the pamphlet may be obtained from E. W. McCullough, manager, department of manufacture, United States Chamber of Commerce, Washington.

Relationships Between Hardness Numbers

The bureau of standards recently has issued a new technologic paper No. 334 in which the relationship between the results obtained by two widely used methods of determining hardness, is given. The brinell and rockwell methods are compared from data obtained from a great many tests on ferrous and nonferrous metals and alloys. Convenient semi-experimental formulas have been derived for converting the hardness number obtained by one machine into terms of the other. Price of the bulletin is 15 cents.

Introduces New Tensile Testing Machine

A new tensile testing machine designed specially to suit the requirements of the British Engineering Standards committee, for the use of both iron and brass foundries, was exhibited at the Birmingham section of the British Industries Fair which was held Feb. 21 to March 4. This machine was designed by F. J. Cook and G. B. Richards, of Birmingham and is manufactured by Pneulec, Ltd. The machine as illustrated has a full load capacity of 12 tons, but larger machines having a capacity up to 60 tons are in course of construction. All sizes of machines are of the hydraulic type, with mineral oil as the working fluid. Test bars of the usual shapes either with shoulders, screwed ends or grips, may be accommodated. An important feature of the machine is that it is arranged so that pull producing the stress is in direct line, and free from side strains, obviating any unreliability in results due to this cause. The working fluid is supplied by a novel four throw pump, having no visible pulsations on the delivery side. The load is shown by a finger on the indicating gage. When the specimen breaks the finger remains stationary and is returned to zero at the will of the operator. The grips are released by a valve.

THE TENSILE TESTING MACHINE HAS A FULL LOAD CAPACITY OF 12 TONS

Describes Respirators for Dusty Air

A bulletin describing the construction and filtering efficiency of dust respirators has been published by the bureau of mines. Various types of respirators are described as is a newly designed type which is constructed according to principles brought out by tests performed on existing types. This bulletin is listed as technical paper No. 394, price 15 cents.

Reorganize Firm

A new company to be known as the Bailey Meter Co., Cleveland, has been formed to take over the flow meter business and patents of the General Electric Co., Schenectady, N. Y. and the fluid meter and combustion control business and patents of the present Bailey Meter Co. Officers of the new company will be E. G. Bailey, president; R. S. Coffin, vice president in charge of finance and administration, and R. E. Woolley, vice president in charge of engineering and sales.

Metal Mixed on Hearth Before Tapping

By R. E. Shadwick

Considerable trouble from hard iron caused me to try many innovations in the operation of the cupola before I finally hit upon the method which has been giving perfect satisfaction for the past year. On account of local conditions iron is tapped directly into 1000-pound ladles and taken to various parts of the foundry. If a mixing ladle had been available it probably would have served the same purpose as the one adopted by which at least two charges of metal are allowed to melt and collect in the well of the cupola before any iron is tapped into the ladles. In this manner a thorough mixture is affected before the metal leaves the cupola. Also the temperature is not affected as it would be to some extent by allowing it to remain some time in a mixing ladle. The percentage of leaky cylinders and heads has been reduced 50 per cent.

Formerly with the best grade of coke and pig iron, trouble was experienced through hard castings even where the pig iron equalled 50 per cent of the mixture. Under the new dispensation the iron is nice and machinable with a 40 per cent pig iron content in the first half of the heat and only 35 per cent used in the second half.

The cupola is lined to 48 inches and we use 1000-pound charges. Each charge placed in the cupola is registered on two dials, connected to each other, one on the charging floor and one on the cupola where the operator can see it, and tap the cupola accordingly.

About an hour before wind time the cupola is filled to the charging door with five charges of iron and coke. The tap hole is stopped when the iron appears and then three additional charges of iron are placed in the cupola before it is tapped. With this arrangement it is apparent that by the time room has been found for the eighth charge, the first two charges must be melted in the bottom of the cupola and the third charge must be passing through the melting zone. Thereafter the cupola is tapped as each succeeding charge is placed in the cupola. In that manner a constant reservoir of molten iron is maintained in the hearth of the furnace. The slag hole is opened after the first tap. It is located at a sufficient height above the bottom to prevent the iron from flowing through until two charges have been melted. This acts as an automatic check and signal. The cupola is tapped immediately before or just as soon as the iron appears at the slag hole. This method of charging also takes care of any variation in the melting time of various charges. Thus if five minutes are required on top to make room for a charge, then the cupola is not tapped for five minutes. If the total charge in the cupola sinks far enough in two minutes to make room for the next charge, the taps are only two minutes apart.

Simplified Practice

Combined efforts of the general conference on wrought iron and steel pipe, valves and fittings has resulted in a reduction from 62 to 49 sizes of pipe and the elimination of 762 sizes of valves according to a bulletin published by the simplified practice division of the department of commerce. Simplified practice recommendation No. 57 may be obtained from the government printing office, Washington, for 5 cents.

Builds Conduit Fittings

The Crouse-Hinds Co., Syracuse, N. Y., recently has introduced a new line of conduit fittings into which is incorporated a new method for fastening the covers and wiring devices to the fitting. A few turns of the screw driver on a special nut fastener causes the cover and wiring device to be held in place securely.

A NEW METHOD IS USED TO HOLD THE COVER

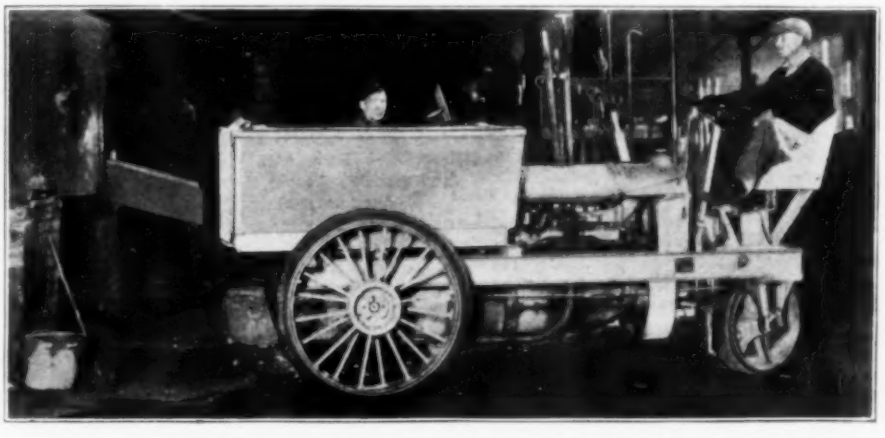
An unobstructed opening is provided which makes it easy to pull conductors through the conduits and the fittings. It also is claimed that the unobstructed cover opening and the large wiring chamber makes splicing and taping easy. The new line is made in a number of different types to meet various wiring requirements.

Uses Tractor Engine in Industrial Truck

The Wehr Co., Milwaukee, has introduced a truck designed to transport various materials in industrial plants. The truck, which is shown in the accompanying illustration, is being employed in the foundry to remove refuse and burned sand, transport core sand from the storage to the core room, haul materials, etc.

The power plant of the truck is the standard unit used in the tractor made by the Ford Motor Co., Detroit, with the exception that a left hand final drive worm and worm gear is substituted for the standard set. The single rear wheel is cast semisteel and is fitted with a solid rubber tire and roller bearings. The bearings and all other parts at the driver's end of the truck are designed to carry a load of 5000 pounds.

Steel spokes of the drive wheels are forged into the cast hub and the steel rim. The side members of the frame are 6-inch channels thoroughly cross braced. The wheel base is 86 inches, the length over all is 11 feet 4 inches and the width 52 inches. By using special equipment the width may be reduced to 47 inches. The turning radius is 7 feet 4 inches. The unit is designed to haul a load of 6000 pounds at speeds from 13/4 to 12 miles per hour.



TRUCK IS DESIGNED TO TRANSPORT MATERIALS IN INDUSTRIAL PLANTS

George H. Walsh has been appointed to take charge of the recently established Boston office of the Young Bros Co., Detroit.

What the Foundries Are Doing

Activities of the Gray Iron, Malleable, Steel and Brass Shops

The A. & W. Brass Foundry, Chicago, recently has been reorganized. G. Puck is manager and A. J. Lunn is secretary.

Mid-City Foundry Corp., Chicago, will remove about June 1 to its new plant at 945 West 49th place.

John Harsch Bronze & Foundry Co., West 116th street and Madison avenue, Cleveland, will build a 2-story addition 60 x 70 feet.

Washington Iron Works, Sixth avenue, Seattle, will build a 1-story forge shop, 48 x 190 feet.

Walworth Co., Kewanee, Ill., A. J. Mather, manager, 313 North Elm, plans to build a foundry building.

Novelty Iron Works, Sterling, Ill., will build a new foundry and machine shop. (Noted April 1.)

Eureka Foundry Co., Gadsden, Ala., maker of cotton mill castings, will build a shop building 60 x 100 feet.

McKim Foundry & Machine Co., Lockport, N. Y., has sold its plant to Harrison Radiator Corp., and work on repairs will start immediately.

Resistant Foundry Co., New Cumberland, W. Va., has been incorporated with $100,000 capital by Peter A. Vacaam, Audry A. Vacaam and Thomas L. Sattarelki.

O. M. Edwards Co., Plum street, Syracuse, N. Y., manufacturer of steel office furniture and hardware specialties, plans the construction of a factory unit.

Griffin Wheel Co., Chicago, which recently acquired the plant of the Standard Car Wheel Co., Cleveland, will repair that plant. (Noted Jan. 1.)

Dayton Industrial association, Dayton, O., C. H. Paul, manager, 922 Dayton Savings & Trust building, contemplates building a brass foundry.

Mechanical Pattern & Foundry Co., 4545 Pacific boulevard, Los Angeles, will build a new foundry, 50 x 100 feet, including in the new equipment a cupola.

Thatcher Furnace Co., Newark, N. J., J. J. Richardson, superintendent, 39 St. Francis street, will build an addition to its factory. (Noted Dec. 1, 1926.)

Imperial Foundries Co., Knoxville, Tenn., has been incorporated with $25,000 capital by C. H. Schriver, Ben H. Testerman and H. S. Burnet.

Link-Belt Co., Indianapolis, A. Kaufman, president, has let the general contract for a 1-story factory to Latham & Walters, 927 State Life building.

Otis Elevator Co., Eleventh avenue and Twenty-sixth street, New York, has awarded the contract for a machine shop to Turner Construction Co., New York. (Noted Nov. 15, 1926.)

Coast Sales Inc., Portland, Oreg., has been incorporated with $1000 capital to engage in general foundry and machine shop business by Edward Barrie, Reuben G. Lenske, and William B. Layton.

Riverside Iron Works, Calgary, Alta., recently has added an electric furnace to its equipment, and now is making steel castings in addition to gray iron castings. About 40 men are employed in the foundry.

Warman Steel Casting Co., East Slausson street, Huntington Park, Calif., G. B. Warman, president, which recently erected a new plant, has increased its capital from $100,000 to $200,000. (Noted March 15.)

Fuller & Warren Co., Troy, N. Y., makers of stoves, will build its second new building to be used as a warehouse for the storage of pig iron. Its enameling plant was opened April 1.

Park City Pattern Works, Bridgeport, Conn., has been incorporated with $50,000 capital to manufacture patterns used in making machinery, by Claude Cady, Alfred V. Danberg and Paul Kovac.

Segal Lock & Hardware Co., 155 Leonard street, New York, has let the general contract for a bronze foundry addition to Bernard Robinson, 101 West Forty-first street, New York.

Penn Boiler & Engineering Works Inc., Reading, Pa., has been incorporated with $25,000 capital to manufacture and design steam, water and hot air boilers, by John J. Daly, J. Ira Long, 242 South Tenth street, and William P. Leonard.

Appleton Electric Co., Chicago, has purchased the complete foundry, equipment, buildings and land formerly owned by the Stowell Co., South Milwaukee, Wis., and are operating it as plant No. 2 under the name of the Wisconsin Appleton Co. (Noted Feb. 15.)

Beaudet Iron Foundry Inc., Boston, has been incorporated with $15,000 capital to manufacture machinery and equipment, by George A. Beaudet, Fred W. Randall, 82 Albion street, Medford, Mass., and Maurice H. Cavanaugh.

Fox River Brass Foundry, Batavia, Ill., recently has been formed to engage in making brass, bronze and aluminum castings. A. J. Moberg and William R. Anderson are officers of the firm which is operated in connection with the Shumway Foundry Co. of that city.

Buick Motor Co., Detroit, according to dispatches will build a gray iron foundry which will cost $5,000,000 and have a capacity of 500 tons a day. Production is planned to start in June. The plant will employ 1700 men and occupy 12 acres.

Controlling interest in the Mueller Brass Co., Port Huron, Mich., has been purchased by Oscar B. Mueller, president, from the Mueller Co., Decatur, Ill. Mr. Mueller has disposed of his interest in the Mueller Co., Decatur, and in the Mueller Ltd., Sarnia, Ont. The Port Huron company will start immediately on a two-year expansion program involving an expenditure of over $500,000 for plant extensions and new equipment.

A merger of several brass and bronze interests is reported to have been effected and will be known as the National Bronze Metal Co., New York. The companies involved in the merger are the Keystone Bronze Co., the Damascus Bronze Co., both of Pittsburgh; Eureka Brass Co., More-Jones Brass & Metal Co., both of St. Louis; Brady Brass Co., Jersey City, N. J.; and the Bronze Metal Co., New York. The Bronze Metal Co. recently acquired the Brady Brass Co., the Southern Brass Works, Portsmouth Va., and the Jersey City plant of the Magnus Metal Co.

Crompton & Knowles Loom Works, Worcester, Mass., has re-elected officers and directors as follows: Homer Gage, president; John F. Tinsley, vice president and general manager; Irving H. Verry and Frederic W. Howe, vice presidents; Edward F. Green, treasurer; Fred J. Bowen, assistant treasurer; John D. Syme, clerk. Directors elected are: Sydenham S. Alexander, Charlotte, N. C.; Fred J. Bowen, George Crompton, Homer Gage, Thomas H. Gage, Albert A. Gordon, Edward F. Green, Frederic W. Howe, George F. Hutchins, Frank B. Knowles, Henry F. Phelps, Philadelphia; Pierpont L. Stackpole, Boston; John B. Syme, Charles M. Thayer, John F. Tinsley, Irving H. Verry, and George E. Warren, Boston.

New Trade Publications

BALL BEARINGS—Ball bearings in electric motors to eliminate wear and augments for their use form the subject matter of a bulletin by the New Departure Mfg. Co., Bristol, Conn. Motors placed at angles to horizontal or perpendicular are shown, with advantages of ball bearings in such use.

STEAM TRAPS—Sarco Co. Inc., New York, is distributing a memorandum book to call attention to the features of its self-adjusting steam trap.

MELTING FURNACE—Steel melting in a high-frequency furnace is the subject of a leaflet by the Ajax Electrothermic Corp., Trenton, N. J., containing data on steel melting and description and illustrations of the apparatus made by this company for this purpose.

CUP WHEEL GRINDER—Machinery Co. of America, Big Rapids, Mich., has issued a bulletin on one style of its line of cup wheel grinders, with data and list of regular equipment.

SLING CHAINS—S. G. Taylor Chain Co., Chicago, has issued a leaflet listing its types of sling chains, prices and safe loads at various angles.

STEEL JOISTS—Standards and loading tables for steel joists are included in a bulletin by the Hall Steel Joint Co., Milwaukee. It covers the construction, markings and specifications of the company's product and gives tables of safe loads. Illustrations of construction using the joists demonstrate the method of use and indicate their strength.

STEEL LOCKERS—Durabilt Steel Locker Co., Aurora, Ill., has issued a loose-leaf catalog of its product, containing description of the various types of lockers, with drawings of construction details and much other valuable material. Considerable text is included for the purpose of aiding the user of lockers to choose types and styles, as well as arrangement of locker rooms. Color plates aid in decorative achievement.

SHOVELS AND SCOOPS—Ames Shovel & Tool Co., Boston, has issued two folders and a complete catalog showing the various types of shovels and scoops manufactured by the firm. Five different examples of molders' shovels with and without peening handles are shown.

REFRACTORIES—Refractory brick for hard use, made from diaspore desposits in Missouri, are featured in a bulletin by the A. P. Green Fire Brick Co., Mexico, Mo. Much attention is paid to describing the raw material and its characteristics and the resulting bricks are presented as to their adaptability.